Λογαριθμοτεχνία,

OR.

The Construction and use *of the Logarithmeticall* TABLES.

By the helpe whereof, Multiplication is performed by Addition, Division by Substraction, the extraction of the square root by bipartition, and of the Cube root by tripartition, &c. Finally, the Golden Rule, and the resolution of triangles as well right lined as sphericall by Addition and Substraction.

First published in the French Tongue by *Edmund wingate*, an English Gentleman:

AND

After translated into English by the same Author.

The third Edition, diligently corrected, and enlarged by the Author himselfe.

ISOCRATES.

Εὰν ἦς φιλομαθὴς, ἔσῃ πολυμαθής.

LONDON,
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M.DC.XLVIII.

TO THE MOST High, and Puissant Prince JEAN BAPTISTE, Gaston de France, the Kings *onely Brother, Duke of* Anjou, &c.

MOst illustrious Prince, the good successe I had a few moneths agoe, in presenting unto your *Highnesse* a Treatise, that contained the uses of a new *Rule* of *Proportion*, hath made mee adventure to present you with this also, which containes the ground, & construction thereof, and besides the *demonstration* of all that is therein handled: True it is, I feared to seem rash to appear so often before your *Highnesse*, yet (considering the quality of the subject) I thought *this* no lesse *yours* then the *former*, they having inseparable dependency one upon another: Wherefore I promise my self this hope, that although I cannot now avoid the *censure* of rashnesse, yet have I this

to comfort me, that herein I have assayed to doe that whereunto I was wholly obliged. Your *Highnesse* may excuse the meannesse of the present. For great *Princes*, such as your *Highnesse* cannot expect from their inferiours, presents answerable to the *greatnesse* of their quality; but the *Law* that should not admit presents of any other sort, would both deprive them of the *acknowledgment* due unto them, and their Subjects of the *contentment* they may receive to make appear the ardent devotion they have to render them *service*, which I have enforced my self to doe with the greatest affection, and submission, that is possible for him to perform, who desires for ever to remaine

Your Hignesse in

all service

devoted,

EDM. WINGATE

The

The Preface.

FOr as much as amongſt many inventions, that concern the Mathematicks, none can be found comparable to this of the Logarithmes, the worthy labours of thoſe learned men which have indeavoured to advance it, are to be prized accordingly: theſe are, firſt, John Neper, Baron of Merchiſton in Scotland, who hath due right to challenge the firſt invention of the Logarithmes in generall: then, Maſter Henry Brigges, profeſſor of Geometry in the Univerſity of Oxford, to whom is duly attributed the invention, and fabricke of that kind of Logarithmes, of which we treat in this inſuing diſcourſe, and which are farre more expedite, then

those of Master Nepers *invention ; Lastly, Master* Edmund Gunter, *professor of Astronomy in* Gresham *College in London, who hath taken great paines in calculating of a table , containing the* Logarithmes *of the* Sines,*and* Tangents *of all the degrees and minutes of the Quadrant. Now this Treatise following, is nothing else but an orderly* Compendium *as well of the construction, as also of the joynt and severall uses of Master* Brigges *his Logarithmes,and Master* Gunters *said Table : for although the insuing Tables (now published in this Edition) be not the very same with theirs, yet are they taken and collected out of theirs, and do all participate of the self same nature in operation ; and concerning the same Treatise , you shall further observe, that the three first Chapters thereof are nothing else, but an abridgment or rather a briefe expla-*

planatiō of that, which master Brigges *delivers in his Book (intituled* Arithmetica Logarithmica) *wherein I produce no other Tables or Examples, then those which he there useth; not onely because they are aptest to expresse the subject matter; but likewise to the end that this Tract might serve as an introduction to that learned work of his.*

The occasion of composing this Treatise was this: In Anno 1624. *I making a journey into France, had the happinesse to be the first transporter of the use of these inventions into those parts; where as soon as I was arrived divers Mathematicians of the chiefest note in Paris, resorting to my chamber, and I communicating unto them first, the manifold uses of the* Logarithmes *described upon Master* Gunters Crosse-staffe, *they earnestly importuned me to expresse them by some*

ſhort Tractate in the French tongue, which when I had compoſed, and prefixed thereunto a Preface, declaring the whole Hiſtory of the rare invention of Logarithms, (viz. *ſuch as you find at the beginning of this) as alſo of Maſter* Gunters *exquiſite invention for projecting the Logarithmes in plaine, I was adviſed by Maſter* Alleaume, *the Kings chief Engeneir to dedicate my book to* Monſieur *the Kings brother, whoſe favourable admittance thereof, encouraged me not long after to preſent him with this other Treatiſe alſo, which containing the grounds and demonſtrations of all that was handled in the other book, he was alſo pleaſed graciouſly to accept. Thus expecting no leſſe favour at home, then I have already received among ſtrangers, I have now the third time adventured to expoſe this ſhort diſcourſe to the publike view.*

THE

THE CONSTRUCTION & USE OF THE LOGARITHMETICALL TABLES.

CHAP. I.

The Definition, and Nature of Logarithmes in generall.

LOgarithmes *are Numbers, which being fitted to proportionall numbers retain always equall differences.*

So the *proportionall* numbers being 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, &c. you may appoint unto them for *Logarithmes* the numbers subscribed under the letters A, B, C, D, or any other at pleasure; so that the *differences* of those Logarithmes be alwaies *equall*, when the *numbers* unto which they are fitted, are *proportionall*.

Prop. nu.	A	B	C	D
1	1	5	5	35
2	2	6	8	32
4	3	7	11	29
8	4	8	14	26
16	5	9	17	23
32	6	10	20	20
64	7	11	23	17
128	8	12	26	14
256	9	13	29	11
512	10	14	32	8
1024	11	15	35	5
	Log.	*Log.*	*Log.*	*Log.*

But now to the end you may the more easily understand the *nature* of these Logarithmes, observe this *proposition* following.

When of four numbers given, the second exceeds the first as much as the fourth exceeds the third; the sum of the first & the fourth is equall to the sum of the second and the third.

Example, these numbers 8, 14, 17, and 23 being given, the *summe* of 14, and 17 (being added together) is *equal* to the *sum* of 8, & 23. From hence necessarily follows this *Corollary*.

When four numbers are proportionall, the summe of the Logarithms of the mean numbers *is*

is equall to the summe of the Logarithmes of the extreames.

So the four *proportionall* numbers being 2, 8, 16, and 64, and the Logarithme of 2, (in the column of Logarithmes subscribed under the letter C) being 8, the Logarithme of 8, 14; The Logarithme of 16, 17, and the Logarithme of 64, 23; I say the sum of 14 and 17, the Logarithmes of the *mean* numbers, is equall to the summe of 8 and 23, the Logarithmes of the *extreme* numbers, as it appeares by the *example* of the proposition aforegoing.

CHAP. II.

The nature of the Logarithmes spoken of in the Treatise following.

THe numbers continually proportional, which M. *Brigges* (in the calculation of his *Chiliads*) hath proposed to himself, are 1, 10, 100, 1000, &c, to which numbers he hath assigned for Logarithmes, 0000, &c. 10000, &c. 20000, &c. 30000, &c. that is to say, to 1, the Logarithme 0000, &c. to 10, the Logarithme 10000, &c. to 100, the Logarithm 20000, &c. to 1000, the Logarithme 30000, &c. And after sheweth the way how to

to make the *meane* Logarithmes, *viz.* of the numbers placed betwixt 1, and 10; betwixt 10 and 100; betwixt 100, and 1000, &c. ſome of which Logarithmes you ſhall finde placed in the *Tables* following.

I

A	B
1	0,000000
10	1,000000
100	2,000000
1000	3,000000
10000	4,000000
100000	5,000000
1000000	6,000000
10000000	7,000000

&c.

C	D
1	0,000000
2	0,301029
4	0,602059
8	0,903089
16	1,204119
32	1,505149
64	1,806179
128	2,107209
256	2,408239
512	2,790260
1024	3,001299

&c.

In the *firſt* of which, you may obſerve (in the Columne marked by the letter A) a ranke of numbers continually *proportionall* from 1, and over againſt each number his reſpective Logarithm in the other column ſigned by the letter B.

In the *ſecond* table (in the Column noted with the letter C) there is another ranke of numbers, which are alſo continually *proportionall* from 1, and juſt againſt each number his

his proper Logarithm (in the other column signed by the letter D) calculated according to the *reason* and proportion of the Logarithmes in the first *Table*, so that supposing the Logarithme of 1, to be 0, 000000, &c. and the Logarithme of 10, to be 1, 000000, &c. the Logarithme of 2 will be found 0, 301029, &c.

Now having put the Logarithme of 1 to be 0, 000000, &c. and the Logarithm of 10 to be 1, 000000, &c. from hence necessarily follow these *Corollaries*.

1 *The Characteristicks of the Logarithms assigned to the numbers, propounded in the first of the tables aforegoing, increase by unites.*

The *Characteristick* of a Logarithm is the first figure of the same Logarithme; so in the first of the premised *Tables* the Characteristick of 0, 000000, (the Logarithm of 1) is 0; the Charact. of 1, 000000, (the Logarithm of 10) is 1; the Charact. of 2, 000000, (the Logarithme of 100) is 2, and so of the rest in their order; And this Characteristick ought to bee severed by a point or *Comma*, from the rest of the Logarithm, as you may observe by the foresaid *tables*.

2 *The Characteristicke of the Logarithme of any number comprehended betwixt any two of*

of the proportionals in the first Table, differs not from the Characteristick of the Logarithm of the first of those two proportionals.

So in the second *table* aforegoing you may observe that 2, 4, and 8 being numbers comprehended betwixt 1 and 10, the *common* Characteristick of their Logarithmes is 0; *viz.* the Charact. of 0,000000 the Logarithme of 1; Again, 16, 32, and 64, being numbers contained betwixt 10 and 100, the Characteristick of their Logarithme is 1, *viz.* the Characteristick of 1, 000000, the Logarithme of 10; in like manner the Characteristick of the Logarithmes of 128, 256, and 512 (being numbers scituate betwixt 100 and 1000) is 2, which is also the Characteristick of 2, 000000, the Logarithm of 100; and so consequently of all other numbers comprehended between those proportionall numbers of the Table A. B.

3 *The Characteristike of any Logarithm is alwaies an unit lesse, then the number of places, whereof the number, unto which it belongs doth consist*: For if a Logarithme be propounded, which hath for his characteristick 0, the number, unto which that Logarithm appertaines, (by the last *Corollary*) exceeds not 10, and therefore must needs consist but of

one

one onely place ; So in the Table C D 0, 903089 (whose Charact. is 0) is the Logarithme of 8, which is a number that consists of one place; in like manner when a Logarithme is propounded, which hath for his Charact. 1, the number, unto which that Logarithm belongs, consists of *two* places: so again (in the Table C D) 1, 806179 (whose Charact. is 1) is the Logarithme of 64, which therefore consists of *two* places; and so consequently of the rest.

4. *The Logarithmes of this kind ought all to consist of equal places:* For you may propound them to consist either of *seven* places, as those in the premised *tables* A B and C D, or of *fifteen* places, as M. *Brigges* hath thought most convenient (principally for large computations) or of as many places as you please, but when you are once resolved of how many places the Logarithms of your *table* shall consist, you must not alter your first resolution, as to make the Logarithm of 2 to be 301029 *viz.* to consist of *six* places, and the Logarithm of 16, *viz.* 1, 20419 to have *seven*, but rather in this case you are to prefix before 301029 a *cypher* to make it consist also of *seven* places, and then the compleat Logarithm of 2 will be 0, 301029, as in the *table* C D,

C D, which o serves likewise for the *Charact.* of that Logarithm, as before hath been shewed.

5. *In multiplication, the summe of the Logarithms of the multiplicand and of the multiplicator is equall to the Logarithm of the Product.*

For as much as in every multiplication there are four *proportionall* numbers, *viz.* as 1 is to the multiplicand, so is the multiplicator to the product, and the Logarithme of 1 being 0,000000, it is manifest by the *Corollary* of the last chapter, that the *summe* of the Logarithms of the multiplicand and multiplicator is equall to the Logarithme of the product; for *example*, 16 being given to be multiplyed by 4, the product is 64, and here the *proportionall* numbers are 1, 16, 4, and 64 (for as 1 to 16, so is 4 to 64) I say then that the *summe* of the Logarithmes of 16 & 4 (the two *mean* numbers of that proportion (is equall to the *summe* of the Logarithms of 1 and 64 (the two *extremes*) by the *Corollary* last cited; but the Logarithme of 1 being 0,000000 the *addition* thereof alters not the Logarithme of 64, therefore the Logarithme of 64 the product, must needs be equall to the *summe* of the Logarithmes of 16 and 4, the

the termes propounded to be multiplyed: for better explanation of this *Corollary* find in the premised *table* C D the Logarithme of 16, which is 1,204119, as also the Logarithm of 4, being 0,602059, these Logarithms if you add together, their *summe* is 1,806178, which is the Logarithm of 64 (the product) as you may observe by the same *table*: onely here there wants an unit in the last place, but the want of an unit or two in the last figure of the Logarithm either in this, or any other operation whatsoever begetteth no error in the work.

6. *In division, the sum of the Logarithms of the divisor and of the quotient is equall to the Logarithm of the dividend*: For as the divisor is to 1, so is the dividend to the quotient; and therefore (1 being alwaies in *division* one of the *meane* numbers of that proportion) I say, the Logarithme of the dividend, notwithstanding the *Addition* of 0,000000 (the Logarithme of 1) unto it, remaines still the same without alteration: for *example*, 64 being given to be divided by 4, the quotient will be 16, and the *summe* of the Logarithms of 4 (the *divisor*) and 16 (the *quotient*) is equal to the *Logarithm* of 64 (the *dividend*) as appears by the *example* of the last *Corollary*.

7. In any ranke of numbers continually proportionall from 1, the Logarithme of any one of them being divided by the denomination of the power, which it challengeth in the same ranke, the quotient will give you the Logarithm of the root.

In the ranke of the *proportionall* numbers of the *table* C D, 2 being the *root* or first power, 4 the *square* or second power, 8 the *Cube* or third power, 16, the *biquadrate* or fourth power, 32 the *fift* power, 64 the *sixt* power, &c. I say the Logarithm of 4 8, 16, 32, 64, or of any of the other subsequent *proportionals* in that rank being divided by the *Denomination* of the power, that the same *proportionall* claimeth in the same ranke, you shal find in the quotient the Logarithm of 2 the *root*; for *example*, in the same *table* the Logarithm of 4 (the *square* or second power) *viz.* 0,602059 being given, I demand the Logarithm of 2 the *root*, here the *denomination* of the power, that the *proportionall* 4 challengeth in that ranke (being the *square* or second power) is 2, wherefore if 0, 602059 the Logarithm of 4 bee divided by 2, the quotient will be 0, 301029, which is the Logarithme of 2, the *root*, as appeares by the same Table: So likewise 0, 903089, the

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Logarithme of 8 (the *Cube* or third power) being divided by 3, leaves you in the quotient the same 0,301029; and 3,010299 the Logarithme of 1024 (the *tenth* power) being propounded and divided by 10 (the *denomination* of his power) gives you in the quotient 301029, before which if you prefixe 0 for the *Characteristick* (according to the fourth *Corollary* of this chapter (the total is 0,301029, *viz.* the Logarithm of 2 the *root*, as before, and so consequently of the rest.

8. *In any ranke of numbers continually proportionall from 1, the Logarithm of the root being multiplyed by the denomination of any of the powers, the product is the Logarithm of the same power*: this *Corollary* is the *inverse* of the last: for example, in the rank of numbers propounded in the last *Corollary*, 0,301029 (the Logarithme of 2 the *root*) being doubled or multiplyed by 2 produceth 0, 602059, the Logarithme of 4, the *square*, or second power and the same Logarithme 0, 301029 being *trebled* or multiplyed by three produceth 0, 903089 the Logarithme of 8 the *Cube*, or third power, and so of the rest. The truth of these two last *Corollaries* may bee evidently demonstrated by the *definition* of Logarithmes, being considered together with the

12 *Rule* of the 9 chapter of the first booke of my *Arithmetick*.

CHAP. III.

The Genesis or Fabricke of the Logarithmes treated of in the insuing discourse.

THe Logarithme of 1, being put 0, 000000, the Logarithme of 10, 1,000000, the Logarithm of 100, 2,000000, &c. in the next place it will bee requisite to shew the way how to make the Logarithms of the *meane* numbers, *viz.* Of 2, 3, 4, &c. which are situate betwixt 1, and 10; of 11, 12, 13, &c. which are placed betwixt 10, & 100; and so of the rest, which we intend to explain in the resolution of the *Problemes* following.

PROBL. I.

The number 10, *being given to finde so many continuall meanes betwixt it and* 1, *till that continuall meane, which comes neerest* 1, *may bee a mixt number lesse then* 2, *and so neere* 1, *that it may have seven cyphers placed before the significant figures of the numerator.*

Al-

ALthough amongst the *proportionall* numbers of the Table A B, I might make choice of any one of them to effect our present designe, yet because the number 10, being the least, is the fittest for that purpose, I nominate that to bee taken rather then any other; *Having therefore placed after the number* 10,*towards the right hand a competent company of cyphers* (viz. *eight and twenty to the end the operation may be thereby made the more exact*) *extract the square root of that number so enlarged, this done, you shall finde that root to be*

$$3\frac{16227766016837}{100000000000000}$$

Which being a mixt number consisting of three *Integers* and a *Decimall fraction*, may likewise (according to the rules of *decimall Arithmetick*) be more conveniently exprest without the denominator; thus,

3.16227766016837.

Having by this meanes found the exact root of 10, *annex unto that root so found fourteene cyphers more, and then working by that intire number so ordered, as if it were a whole number,*

ber, extract the square root thereof, which you shall finde to be

1.778279410038922.

And so proceeding successively by a continued extraction you are to produce seven and twenty square roots, or continuall meanes betwixt 10 *and* 1, *viz.* such as you finde placed in the *first columne* of the table hereunto annexed; which done, you may observe, that the three last *continuall* meanes (marked by the letters g, *h*, and *l*) *viz.*

1.0000000686238
1.0000000343119
1.0000000171559

are each of them *mixt numbers* lesse then 2, and greater then 1, and likewise to have *seven cyphers* placed before the *significant figures* of their *Numerators*, according to the demand of this present *Probleme.*

	10,0000,&c.	1,000000000000000	
A	3,16227766016837	0,50000000000000	D
B	1.77827941003892	0,25000000000000	
C	1.33352143216332	0,12500000000000	
	1.15478198468945	0,06250000000000	
	1.07460782832131	0,03125000000000	
	1.03663292843769	0,01562500000000	
	1.01815172171818	0,00781250000000	
	1.00903504484144	0,00390625000000	
	1.00450736425446	0,00195312500000	
	1.00225114829291	0,00097656250000	
	1.00112494139987	0,00048828125000	
	1,00056231260220	0,00024414062500	
	1.00028111678778	0,00012207031250	
	1.00014054851694	0,00006103515625	
	1.00007027178941	0,000030517578125	
	1.00003513527746	0,000015258789062	
	1.00001756748442	0,000007629394531	
	1.00000878270363	0,000003814697265	
	1.00000439184217	0,000001907348632	
	1.00000219591867	0,000000953674316	
	1.00000109795873	0,000000476837158	
	1,00000054897921	0,000000238418579	
	1000000027448957	0,000000119209289	
	1.00000013724477	0,000000059604644	
G	1000000006862238	0,000000029802322	N
H	1.00000003431119	0,000000014901161	K
L	1.00000001715559	0,000000007450580	M

After

After the same manner may you find out as many *Continuall meanes*, as you please, betwixt any other number given and 1, if you joyne *cyphers* thereunto, as you have been directed to annex them unto the number 10: Neverthelesse here observe, that although (by the resolution of this *Probleme*) you are advised to extract so many *continuall meanes*, that the last should have but *seven cyphers* before the significant figures of his numerator; yet you are to understand that this is onely necessary when you intend that the Logarithms of the *table*, you are to make, should consist of *seven places*, as those in the premised Tables, A B, and C D; for when you intend the Logarithmes of your Table shal consist of *eight*, *ten*, *twelve*, *fifteen*, or of any other greater number of figures, it will be requisite to produce so many continuall meanes, till the last of them may have as many cyphers, before the significant figures of his numerator, as the Logarithmes of your intended table shall have *places*.

PROBL. II.

The Logarithm of 10, *being given to make the Logarithmes of all the continuall*

tinuall meanes contained betwixt 10. *and* 1.

THis Probleme may easily be resolved by the seventh Corollary of the last chapter; for (in the Table aforegoing) the number a *being the square root of* 10, *if you divide the Logarithm of* 10 *by* 2, *you have the Logarithm of the said number* a *: in like manner dividing the Logarithm of the number* a *by* 2, *you have the Logarithm of the number* b, *& so proceeding in the same order, the Logarithmes of all the continuall means betwixt* 10 *&* 1 *may be easily found out.*

For *example*, in the second Column of the *Table* aforegoing 1,00000000000:000 being assigned the Logarithm of 10, halfe of it, *viz.* 0,50000, &c. signed by the letter *d*, is the Logarithm of the number *a* (the *square root* of 10, by the *Corollary* last cited: In like manner 0,25000, &c. being halfe 0,500·0, &c. is the Logarithme of the number *b*, and 0, 25000, &c. the Logarithme of the number *c*, and so consequently of the rest; so that at last as you have in the first Column of the last *Table* 27 *continuall means* betwixt 10 and 1, as aforesaid; so may you likewise make (by the resolution of this *Probleme*) for all those

continuall meanes, respective Logarithmes, as you may observe them placed in the other columne of the same *Table*.

PROBL. III.

A mixt number being given, which being lesse then 2, and greater then 1, comes so neere unto 1, that it hath seven ciphers placed before the significant figures of the numerator, to make his proper Logarithme.

BEfore we come to the resolution of this *Probleme*, this proposition following must first be observed.

When a mixt number, which being lesse then 2 and greater then 1, comes so neer to one, that it hath seven cyphers placed before the significant figures of the Numerator; the first seven significant figures of his Numerator are double the first seven significant figures of the Numerator of his square root.

For *example*, the number 1.00000006862238562102573718748 2, being propounded, which being a *mixt* number lesse then 2, and greater then 1, hath *seven* ciphers placed before the significant figures of his Numerator. *I say*, 6882238, the first *seven* significant figures of his numerator are *double* to 3431119 the

the first *seven* significant figures of the numerator of the number 1,00000003431119 2, which is the *square root* of the same number so propounded: And this observation holds likewise true in all other numbers of the same kind, though they have moe or fewer cyphers then *seven* placed before the significāt figures of their Numerators; for look *how many* cyphers are so placed before the significant figures of their Numerators, *so many* of their first significant figures are double to *as many* of the first significant figures of their *square roots*: Howbeit, the reason, why in this proposition I confine my selfe againe to the number of *seven* figures, is, because *so many* onely are considerable for the making of the ensuing *Tables*, whose Logarithmes I intend shall consist of *seven* places, according to the *reason* formerly alledged in the first *Probleme* of this chapter.

From hence follow these Corollaries.

1. *The significant figures of the Numerator of a number of this kinde, and the significant figures of the Numerator of his square root lessen themselves like their Logarithmes, that is to say, by halfes.*

For *example*, in the lower end of the *table* aforegoing, as the Logarithm *k* is *halfe* the

Logarithme *n*;so 3431119,the significant figures of the Numerator of the number *h*,are the *halfe* of 6862238, the significant figures of the Numerator of the number *g*.

2. *Therefore any two numbers of this kinde being given;their Logarithms,and the significant figures of their Numerators are proportionall.*

Example,the numbers of *g* and *h* being given,I say,as 6862238, the significant figures of the Numerator of the number *g*,are to 3431119,the significant figures of the Numerator of the number *h*;so is *n*,the Logarithme of the said number *g* to *k*, the Logarithm of the said number *h* : In like manner the numbers *g* and *l* being given, as 6862238 is to 1715559,so is the Logarithm *n* to the Logarithm *m*.

And this Rule holds true in any other number of this kinde,though it be not one of the *continuall meanes* betwixt 10 and 1 : for the significant figures of the Numerator of any such number beare the same *proportion* to his proper *Logarithm*, that the significant figures of any of the numbers marked by the letters *g*,*h* or *l* beare to *his*.

These things being thus cleared,it is manifest,that a number of this *kinde* being given,the Logarithm thereof may be found by the *Golden Rule*: For,

As

As the significant figures of the Numerator of any one of the numbers (signed in the first column of the last Table by the letter g, h *or* l*) are to his respective Logarithm :*

So are the significant figures of the Numerator of the number given, to the Logarithme of the same number.

Example, the number 1.00000001021301 being given, I demand the Logarithme thereof : I say then,

As 6862238 the *significant figures* of the numerator of the number g, are to 29802322, the Logarithm of the same number g.

So are 1021301, the *significant figures* of the Numerator of the number given, to 4357281, the Logarithm required.

Before which if you prefix nine ciphers, to the intent it may have as many places as the Logarithmes in the last premised *Table*, (*viz.* 16) according to the fourth *Corollary* of the last *Chapter*, the true and intire Logarithme of 1,00000001021301, the number given, is 0,0000000004357281 ; and thus at last you have the cleare resolution of the *Probleme* propounded.

PROBL. IV.

Any number whatsoever being given, to make the Logarithm of the same number.

YOu may make the Logarithm of any number whatsoever, if first you produce so many continuall meanes betwixt the same number and 1, till the continuall meane, which comes neerest 1 may have seven cyphers placed before the significant figures of his Numerator; For, this being done, you may readily find out the Logarithm of that continuall mean; & then by often doubling & redoubling that logarithm so found (according to the number of the continuall meanes at first produced) at last you shall fall upon the Logarithm of the number given.

Example, the number 2 being given, I demand the Logarithme thereof: Here first (according to that which hath formerly been taught in the first *Probleme* of this Chapter) I produce so many *continuall means* betwixt 2 and 1, till that which comes neerest 1 hath *seven* ciphers placed before the significant figures of the Numerator, which after *three* and *twenty* continued extractions I finde to bee 1,0000000826958; This *continuall meane* being

being thus found, (by the direction of the *Probleme* aforegoing) I finde the Logarithme thereof, which is 0,000000035885571 (For

As 6862238 *to* 29802322,
So 8262958 *to* 35885571)

This Logarithm being *doubled* will produce (by the last *Corollary* of the second chapter) the Logarithme of the *continuall meane* next above 1.0000000826 2958; and so if you *double* successively the Logarithme of each *continuall meane*, one after another, according to the number of the extractions (*viz.* *three* and *twenty* times in all) at last you shall happen upon the Logarithm 0,30102998797 5168, which is the Logarithm of 2, the number propounded: The whole frame of the work is plainly set down in the *Table* following; For in the first Columne thereof you have three and twenty *continuall means* betwixt 2 and 1, and in the other Columne you shall finde the respective Logarithmes, which are produced by a continued *doubling* and *redoubling* of 0,000000035885571, the Logarithme of 1.0000000826 2958, the last *continuall meane* in the *Table*.

2,0000,&c.	0,301029987975168
1. 414213562373 09	0,150514993987584
1, 189207115002 72	0,075257496993792
1. 190507132665 25	0,037628748496896
1, 044273782432 20	0,018814374248448
1. 021897148656 45	0,009407187124224
1. 010889286052 85	0,004703593562112
1. 005429901113 87	0,002351796781056
1. 002711275050 73	0,001175898390528
1, 001354719892 37	0,000587949195264
1. 000677130693 19	0,000293974597632
1. 000338508052 74	0,00014698;298816
1, 000169239705 33	0,000073493649408
1, 000084616272 71	0,000036746824704
1, 000042307241 40	0,000018373412352
1, 000021153396 96	0,000009186706176
1. 000010576642 55	0,000004593353088
1. 000005288307 29	0,000002296676544
1, 000002644150 15	0,000001148338272
1, 000001322074 20	0,000000574169136
1. 000000661036 88	0,000000287084568
1. 000000330518 38	0,000000143542284
1, 000000165259 17	0,000000071771142
1. 000000082629 58	0,000000035885571

But

But now (becauſe the Logarithmes of our intended *Tables* ſhall conſiſt onely of *ſeven* places, (according to the obſervation made in the end of the firſt *Probleme* of this *Chapter*) Of the Logarithme 0,30102998707 5168 I take onely the firſt *ſeven* figures, towards the left hand, adding 1 unto the ſeventh figure, becauſe the eight figure (being 9) doth almoſt carry the value of an unite to the ſame ſeventh figure; and then at laſt the preciſe Logarithme of 2, the number given, will bee found 0,301030: And thus as the Logarithme of 2 is made, ſo may you likewiſe make the Logarithme of any other number whatſoever; Howbeit the Logarithmes of ſome few of the *prime* numbers being once thus diſcovered, the Logarithmes of many other *derivative* numbers may be found out afterwards without the trouble of ſo many continued *extractions* of the ſquare root. For *example*, having thus made the Logarithm of 2, you may eaſily know the Logarithme of 5; for dividing 10 by 2, the quotient will be 5; but the *ſumme* of the Logarithmes of the diviſor, and the quotient, is equall to the Logarithme of the dividend (by the ſixt *Corollary* of the ſecond Chapter.) And therefore if you ſubſtract 0,301030 (the Logarithme of 2)

 from

from 1,000 000 (the Logarithme of 10) the remainder (*viz.* 0, (98970) is the Logarithm of 5.

Againe, besides the Logarithm of 5, with like *facility* you may finde the Logarithme of any other number, that is made by the multiplication or division of these three numbers 2, 5, and 10, *viz.* Of the numbers 4, 8, 16, 32, 64, &c. Of the numbers 25, 125, 625, &c. Of the numbers 20, 50, 100, 200, &c. following the direction given you in the foure last *Corollaries* of the second chapter.

After this manner is that *Table* calculated, which you shall finde in the first page of the *Tables* placed after this discourse, which you may observe to consist of six Columnes, whereof the first, third, and fift, signed by the letter N.) containe all absolute numbers from 1. to 100; and in the second, fourth, and sixt, (entituled Logar.) is placed just against each number his respective Logarithme: So in the second columne of the same *Table*, 0,477121 is the Logarithme of 3; In the fourth, 1,556-303 the Logarithme of 36; and in the sixt columne 1, 838849 is the Logarithme of 69, &c.

And this *Table* may serve to shew you, how the *Tables* of Logarithmes (though never so large)

large) are usually ordered; for *regularly* all the absolute numbers ought to be set downe at large, and just against each number (in the next *Columne*) ought to be placed his respective Logarithme, as you may observe them in the same *Table*: But now if I (intending in this Edition to present to the *publike* the Logarithmes of all absolute numbers from 1 to 400000) should observe the same order, that *Table* would too much incumber this little volume which I intend portable: And therefore I have invented another *Table*, which immediately followeth the foresaid Table of 99 Logarithmes, and is intituled (*The Table of Logarithms*) wherein the Logarithmes of all absolute numbers under 10000 are expressely set down, and by helpe whereof the Logarithmes of all absolute numbers under 400000 may bee also readily discovered, as shal more plainly appear hereafter.

And now for the *description* of this last mentioned *Table*, you may observe, that it consists of twelve *Columnes*, *viz.* six in the *left* hand pages, and other six in the *right* hand pages; of these twelve *Columnes*, the first (noted at the top of every page by the letter *N*) containes all the *absolute* numbers from 1 to 1000, as they stand one after another in their

natu-

naturall order. Again, the ten *Columns* (intituled by the figures 0, 1, 2, 3, 4, 5, 6, 7, 8, 9) containe Logarithmes without their *Characteristiks*, or first figures. And lastly, in the twelfth *Columne* (marked by the letter *D*) are set down the *common differences* of those Logarithmes. And note, that the *Characteristiks* of Logarithms are quite left out of these *Tables*, because *they* without the *Tables* may bee readily discovered, and the *Tables* being exprest without *them*, are thereby made more apt for generall use, as you shall bee more plainly taught hereafter.

As for the other *Table*, which follows this *Table* of *Logarithms* (intituled *Artificial Sines and Tangents*) it is no other then an ordinary *Table* of *Artificiall Sines* and *Tangents*, which are the Logarithmes of the right *Sines* and *Tangents*, set forth by *Rheticus*, *Petiscus*, and others: Of this I need make no other *description*, then onely to name it, because the *disposition* thereof differs not from the *order* of other *Tables* of the same kinde.

CHAP.

CHAP. IV.

The use of the Logarithmeticall Tables in finding out the Logarithme of any number, and the number of any Logarithme propounded.

THus farre the *construction* of the Logarithmeticall Tables, now come we to their *use*, which is twofold:

1. *To find the Logarithm of any number, or the number of any Logarithm given.*

2. *To resolve divers necessary Problemes in Arithmetik and Geometry.*

As for the *first* of these, you shall finde it explained in these *Problemes* following.

PROBL. I.

A whole number under 100 *being given, to fine the Logarithme thereof.*

TVrne to the Table of six columns (which you shall finde upon the first Page of the insuing Tables) this done, having found the number given in the first, third, or fift columne of that Table, just against that number in the next Columne towards the right hand, you shal finde the Logarithme required.

So

So in that *Table*, the Logarithme of 20 will be found 1,301030, and the Logarithm of 75 is 1,875061, &c.

PROBL. II.

A Whole number that consists of three places being given, to finde the Logarithme thereof.

Finde the number propounded in the first Columne of the Table, intituled the Table of Logarithmes (signed with the letter N.) *this done, just against that number in the next Columne, (signed by* o) *you shall finde a number consisting of six figures, before which if you prefix a Characteristik, correspondent to the number propounded, that intire number so ordered is the Logarithme required.*

Example, 125 being given, I demand the Logarithme thereof: The number 125 I finde in the first Columne of the *Table* of Logarithmes, upon the first Page of the same *Table*, aud just against it in the next Columne (signed by *O*) I finde 096910; now if before 096910 I prefix 2, for the *Characteristik* (because the number given consists of *three* figures or places, according to the second *Corollary* of the second Chapter aforegoing

going) the Logarithme of 125 the number propounded will be found 2,096910 : So likewise (upon the third Page of the same Table) you shall finde 2,176091 to be the Logarithme of 150, and (page 5) 2,267172 to be the Logarithme of 185, &c.

PROBL. III.

A number that consisteth of four places being given, to finde the Logarithme thereof.

Finde the three first figures of the number given in the first Column of the Table of Logarithmes, as before; then search the last figure thereof amongst the figures, placed in the top of the Pages, where you have so found those three first figures: this done, just against those three first figures, in the Columne under the last figure, you shall finde a number, before which, if you prefix a proper Characteristik for the nnmber given, that intire number so ordered is the Logarithme you looke for.

Example, 1257 being propounded, I demand the Logarithme thereof; 125, the *three first* figures of the number given, I finde (as before) in the first Columne of the Table of Logarithmes, and likewise 7, the *last* figure thereof

So in that *Table*, the Logarithme of 20 will be found 1,301030, and the Logarithm of 75 is 1, 875061, &c.

PROBL. II.

A Whole number that conſiſts of three places being given, to finde the Logarithme thereof.

Finde the number propounded in the firſt Columne of the Table, intituled the Table of Logarithmes (ſigned with the letter N.) *this done, juſt againſt that number in the next Columne, (ſigned by* o) *you ſhall finde a number conſiſting of ſix figures, before which if you prefix a Characteriſtik, correſpondent to the number propounded, that intire number ſo ordered is the Logarithme required.*

Example, 125 being given, I demand the Logarithme thereof: The number 125 I finde in the firſt Columne of the *Table* of Logarithmes, upon the firſt Page of the ſame *Table*, aud juſt againſt it in the next Columne (ſigned by *O*) I finde 096910; now if before 096910 I prefix 2, for the *Characteriſtik* (becauſe the number given conſiſts of *three* figures or places, according to the ſecond *Corollary* of the ſecond Chapter aforegoing

going) the Logarithme of 125 the number propounded will be found 2,096910: So likewise (upon the third Page of the same Table) you shall finde 2,176091 to be the Logarithme of 150, and (page 5) 2,267172 to be the Logarithme of 185, &c.

PROBL. III.

A number that consisteth of four places being given, to finde the Logarithme thereof.

Finde the three first figures of the number given in the first Column of the Table of Logarithmes, as before; then search the last figure thereof amongst the figures, placed in the top of the Pages, where you have so found those three first figures: this done, just against those three first figures, in the Columne under the last figure, you shall finde a number, before which, if you prefix a proper Characteristik for the nnmber given, that intire number so ordered is the Logarithme you looke for.

Example, 1257 being propounded, I demand the Logarithme thereof; 125, the *three first* figures of the number given, I finde (as before) in the first Columne of the Table of Logarithmes, and likewise 7, the *last* figure thereof

thereof, upon the next Page in the top of the ninth Column of the same *Table*: this done, in the angle of *Position* (just against 125, and under the figure 7) I observe this number, 099335, before which having placed 3 for the correspondent Characteristik of 1257, (being a number of *four* places) at last I produce 3,099335, which is the true Logarithm of the said 1257, the number propounded. In like manner 3,096910 is the Logarithm of 1250, and 3, 636989 the Logarithm of 4335, &c.

PROBL. IV.

A number that consisteth of five places being given, to finde the Logarithme thereof.

Finde the Logarithme of the four first figures thereof (besides the Characteristik) by the probleme aforegoing; this done, observing the common difference (in the twelfth and last columne of the Table, just against the three first figures of the number given, found in the first columne) multiply that difference by the last figure of the number given, and cutting off one figure from the product towards the right hand, adde the rest thereof to the Logarithme

rithme found: last of all, if you prefix before that Logarithme so found the proper Characteristik of the number given, that Logarithm so ordered is the Logarithm required.

Example, 12572 being propounded, I demand the Logarithme thereof; by the Probleme aforegoing the Logarithme of 1257 (besides, the *Characteristik*) is 099335, and the common difference in the last Column of the Table (just against 125, the three first figures of the number given) is 346; which being multiplyed by 2 (the last figure of the number given) the product is 692; wherefore if I adde 69 to 099335, and likewise prefix before that summe 4, (the proper *Characteristik*, of the number given) at last I shal produce 4,099404, which is the Logarithme of the number propounded. So 4,099335 is the Logarithm of 12572, and 4,911205 the Logarithm of 81509, &c.

PROBL. V.

A number that consists of six places (under 400000*) being given, to finde the Logarithm thereof.*

FInde the Logarithm of the first foure figures thereof, (besides the Characteristik) as before

fore; This done, multiply likewise, as before, the common difference by the two remaining figures of number given; then cutting off two figures from the product towards the right hand, if you adde the rest thereof to the Logarithm found, and prefix, as before, a proper Characteristik, that Logarithm so ordered is the same you looke for.

Example, let 125724 be the number propounded, and let the Logarithm thereof bee required: The Logarithm of 1257 (besides the Characteristik) is 099335, and the common difference is 346, which if you multiply by 24 (the two last figures of the number given) the product will be 8304: Now therefore if I adde 83 to 099335, their *Aggregate* is 099418, before which if I prefix 5 (the respective *Characteristik* of the number given) at last I produce 5,099418 for the correspondent Logarithm of the number propounded.

PROBL. VI.

A fraction being given, to find the Logarithm thereof.

DEduct the Logarithme of the Numerator out of the Logarithme of the Denominator

tor; This done, the Remainder is the Logarithm of the fraction propounded.

Example, $\frac{3}{4}$ being propounded, the Logarithme thereof is 0,124938; for (by the first Probleme of this Chapter) the Logarithm of 4 is 0,602060, out of which if I substract 0,477121 the Logarithme of 3, the remainder is 0,124939, the Logarithme of $\frac{3}{4}$ the number propounded. So likewise 1,002425 is the Logarithme of $\frac{125}{1257}$ 2,002494 the Logarithme of $\frac{125}{12572}$ &c. as appeares by the work following.

125	2,096910	125	2,096910
1257	3,099335	12572	4,099404
	1,002425		2,002494

But here observe, that the Logarithme of a fraction, or broken number is alwaies defective, that is, the value thereof is alwaies lesse then 0, or nothing, for the Logarithme of 1 being put 0,000000, the Logarithme of $\frac{3}{4}$, which is lesse then 1, must needs be lesse then nothing; and by how much neerer a fraction approaches to 1, by so much lesse is the quantity of his Logarithme, *& è contra*: because as the Logarithmes of numbers, that

are

are greater then 1, increase *à nihilo ad infinitum* above 1; so the Logarithmes of numbers lesse then 1, increase likewise *à nihilo ad infinitum* under 1: when therefore you meet with a Logarithme of this kinde, to distinguish it from a perfect Logarithme, prefix before it this marke ——, as in the examples before premised: See my *Arithmetik* Lib. 2. *Cap.* 6. *R.* 2.

In like manner these Decimall Fractions $\frac{25}{100}$ and $\frac{05}{100}$ being propounded (which likewise may be written without their denominators, thus, 25, and thus, 05) I say, their Logarithmes are ——0,602060, & —— 1,301030 as may appeare by the work following.

25	1,397940	5	0,698970
100	2,000000	100	2,000000
	——0,602060		——1,301030

Howbeit, when the Fraction propounded is a Decimall, you may more easily finde the Logarithme thereof, thus; First finde the rest of the Logarithm of the Decimall given (besides the Characteristik) as if it were a whole number; then taking the complement which that Logarithm wants of the intire Logarithm of 10, *if you place before that complement his proper* Cha-

Characteristik (which ought to consist of so many units, as the Decimall given hath ciphers prefixt before it) that complement so ordered is the Logarithm required.

Example, the Decimall, 125 being given, I demand the Logarithme thereof; the Logarithm of 125 besides the Characteristik (by the second Probleme of this Chapter) is 096910, whose complement to the Logarithme of 10 is 903090 (for if you subtract 096910 out of 1,000000, the intire Logarithme of 10, the remainder is 903090;) now therefore if before the complement 903090 you place the Characteristik 0 (because the Decimall given hath no cyphers prefixt before it) the intire Logarithme of 125 will be found—0,903090: So likewise the Logarithme of 0125 is—1, 903090, and the Logarithme of 00125 is—2,903090, &c.

PROBL. VII.

A mixt number being given, to finde the Logarithm thereof.

Reduce the mixt number into an improper Fraction; this done, if you subtract the Logarithme of the Denominator out of the Logarithme of the Numerator, that which remaines is the Logarithme required.

Ex-

Example. The mixt number 125 $\frac{3}{4}$ being propounded, I demand the Logarithme thereof; That number being reduced to an improper Fraction, is $\frac{503}{4}$ likewise the Logarithm of 503, the Numerator) by the second Probleme of this Chapter) is 2,710568, and the Logarithme of 4, the Denominator (by the first Probleme of this chapter) is 0,602060, wherefore if I deduct 0, 602060 the Logarithme of 4 out of 2,710568 the Logarithme of 503, the remainder, *viz.* 2,108508 is the Logarithme of 125 $\frac{3}{4}$ the number propounded.

Here when the fraction annexed is a Decimall, you may likewise finde the Logarithme thereof, thus; conceiving the number given to be a whole number, finde the rest of the Logarithme thereof (besides the Characteristik) by the 1,2,3,4, or 5 Problemes aforegoing; this done, if you place before that Logarithme so found, his proper Characteristik, (viz. a figure consisting of so many units, wanting one, as the whole part of the number given consists of places) that intire Logarithm so ordered is the Logarithm required

Example, The number 125 $\frac{72}{100}$ which likewise may be expressed without the Denomi- nator

nator,thus,125.72,or thus,125|72) being given, I demand the Logarithme thereof; the Logarithme of 12572 (besides the Charact.) is 099404 (by the fourth Probleme of this Chap.) before which if I prefix 2, (because 125 the whole part of the number given consists onely of three places) that intire Logarithm so ordered is 2,099404, which is the logarithm of 125 72 the number propounded.

You may perceive by that which hath been delivered in these two last Problemes, that when the fractions propounded are *Decimals*, their Logarithmes are more easily found, then when they are other Fractions; whereupon I have caused the insuing Table to bee hereunto annexed, which may serve for the Reduction of compound Fractions, *viz.* of the fractions of *Coin, weights, Measures, Time & Dozens*) to *Decimals*, to the end that when any such termes come in question, their Logarithms may be the more readily discovered: howbeit here (lest I should too much inlarge this little Volume) I intend onely to present the Table it selfe, referring those that desire to be better informed concerning it to the eleventh Chapter of the first book of my *Arithmetik*.

The

The Table of Reduction.

English Money.

19	95	11	55	3	15	6	025
18	9	10	5	2	1	5	020833
17	85	9	45	1	05	4	016667
16	5	8	4	11	04583	3	0125
15	75	7	35	10	041667	2	a83333
14	7	6	3	9	0375	1	a41667
13	65	5	25	8	033333	3	a3125
12	6	4	2	7	029167	2	a20833
						1	a10417

Troy weight.

11	91667	16	066667	3	0125	13	a22569
50	833333	15	9625	2	a83333	12	a 0833
9	75	14	058333	1	a41667	11	a20833
8	66667	13	054167	23	a39930	10	a19097
7	58333	12	05	52	a38194	8	a15625
6		11	045833	21	a36458	9	a13889
5	41667	10	041667	20	a34772	7	a12153
4	33333	9	0375	19	a32986	6	a10417
3	25	7	303333	18	a3125	5	e86806
2	16667	6	021967	17	a295 4	4	e69444
1	083333	5	025	16	a29778	3	e52083
19	079167	1	020833	15	a26642	2	e34722
18	075	4	016667	14	a243c6	1	e17361
17	070833						

Averdupois

The Table of Reduction.

Averdupois great weight.

H.	5	17	15179	5	044643	8	a44643
qu	25	16	14286	4	035714	7	a39063
27	24107	15	13393	3	026786	6	a33482
26	23214	14	225	2	017857	5	a27902
25	22321	13	11607	1	a89286	4	a22321
24	21429	12	10714	15	a83705	3	a16741
23	20536	11	098214	14	a78125	2	a11161
22	19643	10	089286	13	a72545	1	e55804
21	1875	9	080357	12	a66964	3	e41853
20	17857	8	071429	11	a61384	2	e27902
19	16964	7	0625	10	a55804	1	e13953
18	16071	6	053571	9	a50223		

Averdupois little weight.

15	9375	6	375	13	050781	4	919531
14	875	5	3125	12	046875	5	015225
13	8125	4	25	11	042969	3	011719
12	75	3	1875	10	039063	2	a78125
11	6875	2	125	9	035156	1	a39063
10	625	1	0625	8	03125	2	a29297
9	5615	15	058594		027344	3	a19531
8	5	14	054688		023438	1	e97658
7	4375						

Liquid measures.

7	875	3	5	2	25	2	625
6	75		375	1	125	1	3125
5	621			3	9375		

The Table of Reduction.

Dry measures.

7	835	3	375	2	0625	1	a78125
6	75	2	25	1	03125	3	a58594
5	625	1	125	3	023438	2	a39063
4	5	3	09375	2	015625	1	a19531

Yards and Ells.

3	75	3	1875	1	0625	2	03125
2	5	2	125	3	046875	1	015625
1	25						

Time.

11	91667	30	082193	20	054795	10	027397
10	8333	29	079454	19	052055	9	024657
9	75	28	076714	18	049316	7	021918
8	66[illegible]67	27	073973	17	046577	6	019178
7	58333	26	071233	16	043837	5	916438
6	5	25	068495	15	041097	4	01[illegible]699
5	41667	24	065755	14	038357	3	010959
4	33333	23	063016	13	035617	2	a82193
3	25	22	060274	12	032877	1	a54795
2	16667	21	057536	11	030137		a27397
1	083333						

Dozens.

The Table of Reduction.

Dozens.

10	91667	5	41967	11	076389	5	034722
11	83333	4	33333	10	069444	4	027778
9	75	3	25	9	0625	3	020833
8	66667	2	16667	8	05555	2	013889
7	58333	1	083333	7	048611	1	a69444
	5			6	041667		

PROBL. VIII.

The rest of a Logarithm (besides the Characteristik) being given, to find all the figures of the number, unto which it appertaines.

SEarch the rest of that Logarithm (besides the Characteristik) in the second column of the Table of Logarithmes, where if you find it exactly, the figures just against it in the first Column are the figures of the number you look for: So if 096910 were propounded, the figures of the number, unto which it belongs would be found 125, and 698970 being given, the figures of the number, unto which it appertaines, are 5[illegible]0, &c.

But here if you finde not the Logarithm given

precisely, observe (as before in the second column of the Table) that which being least comes neerest unto it, then casting your eye in the same line towards the right hand upon the other nine columnes of Logarithmes, make search in them for the Logarithm propounded, where if you finde it exactly, the three figures in the first Column & the figure placed at the top of the column (where you found the Log. given) being annexed together are the figures of the number unto which the same Logarithm appertaines: So the Logarithm 099335 being propounded, the figures of the number unto which it belongs are 1257, as appeares by the first example of the third Probleme of this Chapter.

But lastly, if yet in the other nine columnes you find not the exact Logarithm propounded, take (as before) that which being lesse comes neerest unto it; then deducting the Logarithm found out of the Logarithm given, annex unto their difference the figure 9; this done, if you divide that difference so inlarged by the common difference (placed in the last column of the Table just against the Logarithm found) the quotient will yeeld you a figure, which being annexed to the four figures before found, will make up the figures of the number, unto which the Logarithm given doth belong.

So

So the Logarithm 099404 being propounded, the Logarithm that comes neerest it, in the second columne, is 096910, and the Logarithm that comes neerest it, in the other nine columnes, is 099335, above which I finde seven placed at the top; wherefore I take 125 (in the first column) and 7 (in the top of the Table) for the four first figures of the number required, then to finde the last figure, I deduct 029335 (the Logarithm last found) out of 099404 (the Logarithm propounded) and finde their difference to be 69; now therefore if by annexing the figure 9 to 69, I make it 699, and afterwards divide that intire number by 345 (the common difference placed in the last columne of the Table just against the Logarithm found) the quotient will give me 2: whereupon at last I conclude, that 12572 are the figures of the number unto which the Logarithm 092404 doth appertain.

And here obſerve further, that if two figures be required to be annexed to the four figures found, you are to annex 99 to the difference of the Logarithmes, and then divide the whole by the common difference, as before; for this done, the two figures in the quotient are they you deſire. For example,

069418 being propounded, the first four figures of his correspondent number will be 1257, as before, and the difference between 099335 (the Logarithm of 1257, besides the *Characteristik*) and 099418 is 83; now therefore if by annexing 99 unto 83, I make it 8399, and then divide the whole by 346 (the common difference) I finde in the Quotient 24; I conclude therefore, that 125724 are the figures of the number, unto which the Logarithm 099418 doth belong. But this Rule holds onely true when the first foure of the figures thus discovered amount not to above 4000; for when they exceed that number, the sixt figure cannot be taken precisely by our Table, which professeth onely to present the Logarithmes of all absolute numbers under 400000, and no farther.

PROBL. IX.

A perfect Logarithm being given, to finde the correspondent number unto which it belongs.

I Call a perfect Logarithm that, which is the Logarithm of a number not lesse then 1; *now therefore to finde the proper number of such a Loga-*

Logarithm, doe thus : Finde (by the last Probleme) the figures of the number, unto which the Logarithm given doth appertaine : this done, having observed of how many units the Characteristik of the Logarithm propounded doth consist, cut off (towards the left hand) one more of the figures so found (as if the Characteristik be 0, cut off one of these figures, if it be 1 cut off 2, if 2 cut off 3, &c.) for those figures so cut off will be the whole part of the number required; and if (besides) there remaine any figures towards the right hand, they are a Decimall Fraction annexed to the number you look for.

Example, the Logarithm 0,099404 being propounded, I demand the number, unto which it belongs: the figures of the number, whereunto that Logarithm appertaines (by the Probleme aforegoing) are 12572, of which figures (because the Characteristik of the Logarithm given is 0) I cut off 1 towards the left hand, and then the number required will bee found 1|2572, or $1\frac{2572}{1000}$: In like manner the correspondent number of 1,095-404 is 12|572, and the proper number of 2, 009404 is 125|72, &c.

And here it is to be observed, that the quantity

tity of the characteristik ought wholly to direct, of how many places the number required ought to consist; and therefore sometimes you are to annex, and sometimes to cut off certaine cyphers either to or from the figures found in the Table, to the end the number required may be answerable to the Logarithm propounded: For example, if the Log. 0,000000 were given, the number, which 000000 (the rest of that Logarithm besides the characteristik) doth discover in the Table, is 100, from which, because here the characteristik is 0) I cut off the two cyphers, and then the proper number of the Logarithm propounded will be found 1; so likewise the Logarithm 1, 000000 hath for his correspondent number 10, the Logarithme 0,301030 hath 2, the Logarithm 1,301030 20, &c. Contrariwise, the Logarithm 3,000000 being propounded, here the figures answerable (in the Table) to 000000 are 100, as before; but now (because the Characteristik is 3) in this case I am to annex a cypher to 100, and then the proper number) unto which the Logarithm doth belong) is 1000: In like manner 4,000000 is the Logarithm of 10000; 4,301030 the Logarithm of 20000; 5, 096910 the Logarithme of 125000;

5,

5,099335 the logarithm of 125700,5,099404 the Logarithm of 125720, &c.

PROBL. X.

A defective Logarithme being given, to finde the respective number, unto which it appertaines.

A Defective Logarithm is that, which is the Logarithm of a number lesse then 1; *now to finde the correspondent number of such a Logarithm, take this direction: Having found the complement, which the rest of the Logarithm (besides the Characteristik) doth want of the intire Logarithm of* 10, *make search (by the eight Probleme of this chap.) for the figures of the number unto which that complement doth belong; this done, if you place those figures for every unit of the Characteristik, of the Logarithm given, a cypher, and at last prefix a point or dash before all, those figures so ordered are the number you look for, which is always in this case a Decimall fraction.*

Example, the Logarithm ——0,903090 being given, I demand the number unto which it appertaines; The complement of the rest of that Logarithm (besides the Characteristik) to the intire Logarithm of 10, is 096910, and the figures answerable to that

Logarithm (by the eight Probleme aforegoing) is 125: And now becauſe the Characteriſtik of the Logarithm given is 0, I prefix no cypher before 125 but onely a point to ſigne it for a Decimall; this done, the correſpondent number of the Logarithm propounded will be found, 125 or $\frac{125}{1000}$: But if the Logarithm given were —— 1,903090, his reſpective number would be 0125, becauſe the Characteriſtik of the Logarithm propounded is 1: So likewiſe the correſpondent number of 1, 301030 is, 05, and the number unto which —— 2,6 20 0 belongs, is, 0025, &c.

And here obſerve, that the complement of a Logarithm may be readily diſcovered, if neglecting the Characteriſtik you ſubſcribe under each of the other figures thereof his reſpective complement to 9, ſave under the laſt ſignificant figure towards the right hand, under which you are to write his complement to 10: for this done, you have the complement of the Logarithm propounded. *Example*, —— 0,1249;9 being given, his complement to the intire Logarithm of 10 is 875061; for the complement of 1 to 9 is 8, and the complement of 2 to 9 is 7; again, the complement of 4 to 9 is 5, and the complement of 9 to 9 is 0; laſtly, the complement of

3 to 9 is 6, and the complement of 9 to 10 is 1 : Now all these figures (*viz.* 875061) I subscribe one after another under 124939, and then conclude, that the complement of —— 0,124939, the Logarithm propounded is 875061 : so likewise is 397940 the complement of — 0,602090, and 096910 the complement of ——0,063090, as may appear by the operations following.

——0,124939	——0,602060	——0,903090
875061	397940	096910

And this rule may likewise serve for the discovery of the complement of a Logarithm when you are to finde the Logarithm of a Decimall, according to the direction given you in the sixt Probleme of this Chapter.

PROBL. XI.

An Arke or Angle of any number of degrees being given, to finde the Logarithm of the right Sine or Tangent of the same.

VVHen the nũber of the degrees given exceeds not 45, make search for the same degrees at the top of the pages of the

the Table (intituled Artificiall Sines and Tangents*) and for the Minutes (if there be any) in the first Columne towards the left hand, signed by the letter M; this done, just over against those minutes under the Title (Sin.) you shall finde the Logarithm of the Sine, and under the title (Tan.) you shall have the Logarithm of the Tangent of the Ark or Angle propounded*: So the Logarithm of the Sine of an Arke or Angle of 23 Degrees 30 Minutes is 9,600696; and the Logarithm of the Tangent of the same Arke or Angle is 9,638301.

But when the number of the degrees knowne exceeds 45, look them at the bottome of the same Table, and the Minutes in the first Columne towards the right hand signed likewise by the letter M: for this done, just over against those Minutes above the Title (Sin.) you shall discover the Logarithm of the Sine, and above the title (Tan.) you shall finde the Logarithm of the Tangent of the Arke or Angle required: So the Logarithm of the Sine of 66 Degrees 30 Minutes is 9,962397; and the Logarithm of his Tangent is 10,361-698, and so of the rest.

Observe here, that when the Arke or Angle propounded, exceeds 90 Degrees, in stead of it you must look his complement to 180 De-

Degrees, according to that which is practised in the use of the ordinary Tables of Sines, Tangents and Secants.

PROBL. XII.

The Logarithm of a right Sine, or Tangent being given, to finde his correspondent Arke or Angle.

Search in the same Table of artificiall Sines and Tangents the Logarithm propounded, viz. *in the Columnes signed by the title(Sin.) if the Logarithm propounded be the Logarithm of a Sine, or in those signed by the title(Tan.)if it be the Logarithm of a Tangent, this done, in the top or bottome of the columne (where you find the same Logarithm after the title(Sin. or Tan.) you shall discover the Degrees, and just against the Logarithmes found in the columns marked by the letter M. (either upon the right or left hand respectively) you shall have the Minutes of the Arke or Angle propounded.* So 23 Degrees 30 Minutes is the correspondent Arke to 9, 600699, the Logarithm of the Sine of the same Arke, and likewise to 9,638301 the Logarithm of his Tangent.

Observe, that although the numbers, which you

you shall finde in the Table of Sines and Tangents, are properly the Logarithmes of the right Sines and Tangents of the Degrees of the Quadrant, as is aforesaid, yet hereafter when we shall have any occasion to mention them, for brevity sake we will call them Sines and Tangents without any other addition; So 9,600699 is the Sine, and 9,638301 the Tangent of 23 Degrees 30 Minutes.

Again, in stead of the termes Sine or Tangent of the complement, wee will use with Master *Gunter* the words *Cosine* and *Cotangent*: So 9, 600699 is the *Cosine*, and 9, 638301 the *Cotangent* of 66 Degrees 30 Minutes. In like manner 9,962397 is the *Cosine*, and 10, 361698 the *Cotangent* of 23 Degrees 30 Minutes, &c.

Lastly, when you cannot finde precisely the Sine or Tangent you look for, take in stead thereof that which comes neerest unto it.

CHAP. V.

The use of the Logarithmeticall Tables in Arithmetik.

HAving in the last Chapter shewed the first use of the Logarithmeticall tables, come we now to the other, and first to their

ad-

admirable uſe in Arithmetik, which you ſhall find explained in the reſolution of theſe Problemes following.

PROBL. I.

One number being given to be multiplyed by another number, to finde the Product.

VVHen the Logarithmes of the numbers given are both of one kinde (that is, both perfect, or both defective Logarithmes) adde them together; for this done, their ſumme is the Logarithm of the Product required, which Logarithm ſo found, is alwaies of the ſame kinde with the Logarithmes of the number given, viz. *perfect if they be perfect, defective if they be defective.*

Example, 30 being given to be multiplyed by 25, I demand the Product, the Logarithm of 30 (by the firſt Probleme of the laſt Chapter) is 1,477121, and the Logarithm of 25 is 1,397940, the ſumme of theſe Logarithmes is 2,875061, which (by the ninth Probleme of the ſame Chapter) is found to be the Logarithm of 750, the product required; So likewiſe is 09375 the Product of $\frac{3}{4}$ multiplied by 125: for by the ſixt Probleme

bleme of the Chapter last cited) — 0,124-939 is the Logarithm of $\frac{3}{4}$ and — 0,90309-0 the Logarithm of 125, and the summe of these Logarithmes is — 1, 028029, which (by the tenth Probleme of the same Chapter) is the Logarithm of 09375 the product sought for, see the operations following,

30.	1,477121	$\frac{3}{4}$	— 0,124939
25.	1,397940	.125	— 0,903090
750.	2,875061	10375	— 1,002029
			971971

2. *But when the Logarithmes of the numbers given are of divers kinds (that is, one perfect and the other defective) substract the lesser out of the greater; This done, the remainder is the Logarithm of the Product required, which Logarithm is in this case alwaies of the same kind with the greater Logarithm of the numbers given:* So 25 being given to be multiplyed by .125, the Product is 3.125, but the same 25 being given to be multiplied by .00125, the Product is .03125, as appeares by the worke following.

25.	1,397940	25.	1,397940
.125	—0.903090	.00125	—2,903090
3.125.	0,494850	.03125	—1,505150
			4850.

PROBL. II.

One number being given to be divided by another number, to finde the quotient.

BEfore we proceed to the resolution of this Probleme, the proposition following ought to be observed;

In division by Logarithmes, when the dividend is greater then the Divisor, the Logarithm of the quotient is alwaies perfect, & contra.

Because in Division after the Logarithm of the quotient is discovered, there may yet remaine some doubt, whether that Logarithme be a perfect or a defective Logarithm; therefore have I here prefixed this proposition, to the end that difficulty may bee removed: For if you consider the three numbers given in every division, you shall there finde this proportion,

As the Divisor is to the Dividend,
So is 1 to the Quotient;

according to the observation before, made in the sixth Corollary of the second Chapter. I say therefore, when the dividend, which is the second terme, is greater then the Divisor, which is the first terme; the quotient which

is the fourth terme, must needs bee greater then 1, which is the third terme; And therefore in this case the Logarithm of the quotient is alwaies perfect, that is, the Logarithm of a whole or mixt number: Contrariwise, when the Dividend is lesse then the Divisor, the Quotient is lesse then 1; and therefore in this case the Logarithm of the Quotient is alwaies a defective, *viz.* the Logarithm of a Fraction: This being premised, let us now proceed to the resolution of the Probleme propounded.

1 *Therefore when the Logarithms of the numbers given are both of one kinde, substract the lesser out of the greater; this done, the residue is the Logarithm of the quotient.*

Example, 94325 being given to be divided by 3947, the Quotient is 23.898; For the Logarithm of 94325 (by the fourth probleme of the last Chapter) is 4,974627, out of which if I deduct 3,596267, which (by the third probleme of the same Chapter) is the Logarithme of 3947, the remainder is 1,378360, which by the ninth Probleme of that Chapter) is the Logarithm of 23.898 the Quotient required: So likewise if 3947 were propounded to be divided by .0573 the Quotient would bee found 6.8883; for the Lo-

Logarithm of .0573 (by the ſixth Probleme of the laſt Chapter) is —— 1,241845, out of which if you ſubſtract —— 0,403733, which (by the ſame Probleme) is the Logarithm of .3947, thereremaines 0,838112, which by the ninth Probleme of the ſame Chapter) is the Logarithme of 6.8883, as appeares by the worke following

94325.	4,974627	.3947	—0,403733
3947.	3,596267	.0573	—1,241845
23.898	1,378360	6.8883	0,838112

And here in theſe operations you may obſerve, that 8,378360 and 0,138112 the Logarithmes found are both of them perfect, becauſe the whole number 94325, being the Dividend in the firſt example, is greater then 3947, his Diviſor; and the Fraction .3947, being likewiſe the Dividend in the other example, is greater then the Fraction .0573, his reſpective Diviſor, according to the propoſition before premiſed. But contrariwiſe, if in the firſt example 3947 were the Dividend, and 94325 the Diviſor, and in the other example .0573 were the Dividend and 3947 the Diviſor, in this caſe both the Logarithms found would be defective; becauſe then both the

the Dividends would be lesse then their respective Divisors; This likewise will appear plainly upon the view of the operations following.

3947.	3,596267
94325.	4,974627
.041845	—1,378360
.0573	—1.241845
.3947	—0,403733
.14517	—0,838112
	161888

For here——1,378360 being the Logarithm found in the first example, is (by the tenth Probleme of the last Chapter (the Logarithm of the Decimall 041845,and —0,838112, being the Logarithm found in the other example, is(by the same Probleme)the Logarithm of the Decimall.14517.

2 *when the Logarithmes of the numbers given are of divers kindes, adde them together, this done, their summe is the Logarithm of the Quotient.*

Example; 3947 being given to bee divided by .14517 the Quotient is 27188 : For the Logarithm of 3947 is 3,596267, and the Logarithm of.14517 is——0,38112; these

Lo-

Logarithmes being added together, their summe is 4,434379, which being a perfect Logarithm (by the proposition before premised) is the Logarithm of 27188, the Quotient required: But if .14517 were propounded to be divided by 3947, the quotient would be found .000036781, *Causa qua supra*. See the worke,

3947.	3,596267
.14517	—8,838112
27188.	4,434379
.14517	—0,838112
3947.	3,596267
.000036781	—4,434379
	565621

In like manner 6.8883 being given to be divided by .3947, the Quotient is 17.452: for the Logarithm of 6.8883 (by the seventh Probleme of the last Chapter) is 0,838112, and the Logarithm of .3947 is —0,403733, these Logarithms being added together, their summe is 1,241845, which is the Logarithm of 17.452, the Quotient you look for: But if .3947 were divided by 6.8883, the Quotient would be .0573;

6.8883	0,838112
.3947	—0,403733
17.452	1,241845
3.947	—0,403733
6.8883	0,838112
.0573 —	1,241845
	758155

I have thought fit to inſiſt the longer upon the explanation of theſe two firſt Problemes, becauſe Multiplication and Diviſion are indeed (as it were) the two hands, by which almoſt all the other ſubſequent operations of this Treatiſe are framed: for having once gained the right way how to perform them, you may (with much eaſe and dexterity) worke any other operation whatſoever, which may be performed by them: And therefore I hope it will not be needfull in the inſuing Problemes of this Treatiſe to produce examples to expreſſe all the varieties, which they likewiſe will admit (according to the nature of the Logarithmes, by which you are to work) but onely to confine my ſelfe to ſuch examples, which may be performed by perfect Logarithmes: referring thoſe, that are deſi-

desirous to see moe diversities of examples in all Arithmeticall operations, to peruse the second book of my Arithmetik (from the beginning of the seventh Chapter to the end of the same book) where (as I well hope) they shall finde plentifull matter to give them full satisfaction in that point.

PROBL. III.

Three numbers being given, to finde a fourth in a direct proportion.

ADde the Logarithm of the second terme to the Logarithm of the third terme, then from their summ subtract the Logarithm of the first terme; this done, the number that remains is the Logarithm of the fourth term demanded.

Example, Let these three numbers 12, 6, and 432 be given, to which it is required to finde a fourth proportionall: The Logarithm of 6 is 0,778151, and the Logarithm of 432 is, 2635484; the summ of them is 3,413635, from which if I substract 1,079181 the Logarithm of 12 the first terme, the number which remaines is 2,334454, which (by the ninth Probleme of the last Chapter) is the Logarithm of 216, the fourth terme required.

As	12	1,079181
Is to	6.	0,778151
So is	432	2,635484
		3,413635
To 21[illegible].		2,334454

Howbeit here observe, that the rule of this Probleme onely holds true, when the Logarithmes (by which you worke) are all perfect, or all defective Logarithms, but when some of them are perfect, and other some defective the operation will vary: This consideration likewise ought to be had in al the other subsequent Problemes of this Treatise, which hereafter (for brevity sake) I wholly referre to the discretion of the ingenious Reader.

PROBL. IV.

Having three numbers given, to finde a fourth in an inverse proportion.

ADde the Logarithms of the first and second termes together, then out of their summe substract the Logarithm of the third terme; this done, that which remains is the Logarithm of the fourth terme required.

Example, If 375 men in 72 houres can make a Trench 20 pearch in length; in how many

many houres may 133 men make such another of the same length?

Men	375.	2,574031
Houres	72.	1,857332
		4,431363
Men	133.	2,123852
Houres	203.	2,307511

So that 133 men in the space of 203 hours may doe as much as 375 men in the space of 72 houres, for the making of such a Trench, as aforesaid, or any other work whatsoever.

PROBL. V.

Having three numbers given, to finde a fourth in a duplicated Proportion.

D*Ouble the difference of the Logarithms; which belong to the two terms that have the same denomination; then if the first terme be lesse then the second, adde that difference doubled to the Logarithm of the other terme; this done, the summe is the Logarithm of the fourth terme required.*

So the superficiall content of a circle, whose Diameter is 14 inches, being 154 square inches; the content of another Circle, whose Diameter is 28 inches, will be found to be 616 square inches.

Diameter	14	1,146128
Diameter	28	1 447158
Difference		301030
Difference doubled		602060
Content given	154	2,287521
Content required	616	2,189581

But if the first terme be greater then the second, substract the difference doubled from the Logarithm of the other terme.

Example.

Diameter	28	1,447158
Diameter	14	1,146128
Difference		301030
Difference doubled		602060
Content given	616	2,789581
Content required	154	2,187521

PROBL. VI.

Having three numbers given, to finde a fourth in a triplicated Proportion.

TRiple the difference of the Logarithmes, which belong to the two terms that have the same denomination; then, if the first term be lesse then the second, adde that difference to *tri-*

tripled to the Logarithm of the other terme, and so shall you have the Logarithm of the fourth terme demanded.

Example. If a Bullet, whose Diameter is 4 inches, weigh 9 pound; another Bullet, whose Diameter is 8 Inches, will weigh 72 pound.

Diameter	4	0,602060
Diameter	8	0,903090
Difference		301030
Difference tripled		903090
Weight given	9	0,954243
Weight required	72	1,857333

But if the first terme be greater then the second, substract the difference tripled from the Logarithm of the other terme.

Example.

Diameter	8	0,903090
Diameter	4	0,602060
Difference		301030
Difference tripled		902090
Weight given	72	1,857333
Weight required	9	0,954243

PROBL. VII.

Any number being given, to finde the square root thereof.

Divide the Logarithm of the number given by 2; this done, you have the Logarithm of the Root required.

Example.

The number given	12572	4,099404
The Root required	112.12	2,049702

PROBL. VIII.

To finde the Cube root of any number given.

Divide the Logarithm of the number given by 3; this done, you have the Logarithm of the Root required.

Example.

The number given	79304.	4,899295
The Root required	42.963	1,633098

PROBL. IX.

Betwixt two numbers given, to finde a meane Proportionall.

Adde the Logarithmes of the two numbers given together, then dividing their summe by 2, you have the Logarithm of the Meane Proportionall required.

Exam-

Example,

The numbers given —	8	0,903090
	32	1,505150
The summe of their Log.		2,408240
The halfe summe		1,204120

which is the Logarithm of 16, the Mean proportionall demanded.

PROBL. X.

Betwixt two numbers given, to finde two mean Proportionals.

HAving found the difference betwixt the Logarithmes of the numbers given, and added a third part thereof to the Logarithm of the least number propounded, you have the Logarithm of the lesser mean Proportionall you look for; to which if you again adde the same third part, you shall have the Logarithm of the other mean Proportionall required.

Example.

The numbers given	8	0,903090
	64	1,806180
The difference		903090
The third part		301030
The lesser m.prop.	16	1,204120
The greater m.prop.	32	1,505150

PROBL. XI.

A summe of money being forborn for a certain time, to finde how much it will be augmented at the expiration of the same time, accounting interest upon interest, according to a certain rate propounded.

Substract the Logarithm of 100 from the Logarithm of 100, and the rate added together; this done, if you multiply their difference with the time propounded, and then adde that Product unto the Logarithm of the Principall, that summe is the Logarithm of the Principall and Interest required.

Example, I desire to know how much 2735 *l.* being forborne 11 yeers, will be increased at the expiration of those yeeres, accounting interest upon interest after the rate of 8 l. *per centū*: Here if I substract 2,000000 (the Logarithme of 100) out of 2,033424 (the Logarithm of 108) the Remainder is 33424, which being multiplied by a 11 yeers, produceth 367664; wherefore if I now adde the same 367664 to 3,436957 the Logarithm of 2735 (the Principall, or summe of mony

money forborn) their Aggregate is 3,804621 which is the Logarithm of 6,77.1, the Principall increased: So that I conclude, 2735, *l* being forborn 11 yeeres will augment to 6377,*l*.2.s. (for $\frac{1}{10}$ of a pound is 2 shillings) accounting Interest upon Interest according to the rate of 8, *l. per centum.*

PROBL. XII.

A sum being due at a time to come, to finde what it is worth in ready money.

HEre the worke is the same with that of the former Probleme, onely at last in stead of adding, you are to substract the Product out of the Logarithm of the Principall; for that performed, the Remainder is the Logarithm of the summe you look for.

Example. What is 2753, *l.* due to be paid 11 yeeres hence, worth now in ready mony? Here having found the Product 367664, as before, I deduct it out of 3,436957, and find the Remainder to be 3,069293, which is the Logarithm of 1173, *l.* the sum demanded.

PROBL. XIII.

The Principall and the Aggregate of the Principall and Interest together being given, to finde the rate of the interest.

Substract the Logarithm of the Principall out of the Logarithm of the Aggregate; this done; if you first divide the difference by the time, and then adde that Quotient to the Logarithm of 100, that summe is the Logarithm of 100 l. & the rate of the Interest added together.

A delivers to *B* 230, *l.* with *caution* to receive in *lieu* thereof at the expiration of 21 years 850, *l.* and in the Interim to forbeare the Interest; the question is, after what rate of Interest *B* is to hold this money: Here first 2,361728 (the Logarithm of 230) being deducted out of 2,929419, (the Logar. of 850) their difference is 567691, which if I divide by 21, the Quotient is 27033; This Quotient if I adde to 2,000000 (the Logarithm of 100) their summe or Aggregate is 2,027-033, which is the Logarithm of 106. 42 (*viz.* 106, *l.* and $\frac{42}{100}$ of a pound, which Fraction being reduced (by the Table of Reduction produced in the seventh Probleme of the last chap-

chapter) is 8, *s.* 4. *d.* 3. *farth.* I conclude therefore that *B* retaines the 230. l. for the time aforesaid at the rate of 6, l 8, *s*.4, *d*, 3 *far. per centum*, which is the resolution of the Probleme propounded.

PROBL. XIV.

A yeerely rent or annuity being forborn a certain number of yeers, to finde what the arrearages thereof will amount unto, according to any rate propounded.

First discover the Principall, that answers to the rent or annuity in question, then find unto what summe that Principall will be augmented (according to the given rate) at the end of the terme propounded; this done, if you substract the same Principall out of that summe, the Remainder is the summe of the Arrearages you look for.

Example, A rent or annuity of 12, l. *per annum* being forborne 16 yeares, what will the Arrearages thereof amount unto, they being conceived to increase (as they grow due) after the rate of 8, *l. per centum*? Here first to find the Principall that answers to 12, *l.* say thus,

If 8 hath 100 *l.* for his Principall, what ought 12 *l* to have for his correspondent principall?

The answer will be (by the third Probleme of this Chapter) 150, *l.* for the respective Principall of 12, *l.* Having thus discovered the Principall of 12, *l.* *viz.* 150, *l.* I find by the 11 Probleme aforegoing) that the same 150, *l.* being forborne 16 yeers, will amount (after the rate of 8, *l. per centum*) to 513. 89, that is, 513, *l.* 17. *s.* 9, *d.* now therefore if I deduct 150 (the correspondent principall of the Annuity given) out of the same 513, *l.* 17. *s.* 9, *d.* The remainder, *viz.* 363, *l.* 17, *s* 9, *d.* is the summe of the Arrearages required.

PROBL. XV.

A yeerly rent or Annuity being propounded, to find what it is worth in ready money.

First finde what the Arrearages thereof amount unto at the end of the terme propounded, and then what those arrearages are worth in ready mony, which shall likewise be the required price or value of the rent or Annuity propounded.

Example, What may a man which is desirous to lay out his money after the rate of 8, *l. per centum*, afford to give for a lease of 12, *l. per annum*, that hath yet 16 yeers in being? I finde (by the last Probleme) that the Arrearages of 12, *l. per annum*, being forborne 16 yeers, amount then to 363 *l.* 17, *s.* 9. *d.* or 393. 89, and I finde likewise (by the twelfth Probleme aforegoing) that the same 363, *l.* 17, *s.* 9. *d.* is worth in present money 106.21. *l.* or (which is all one) 106. *l.* 4, *s.* 2, *d.* I conclude therefore, that the value of the lease propounded (at the rate of 8, *l. per centum*) is 106, *l* 4, *s.* 2, *d.*

Here when the terme of the Annuity beginnes not presently, but after certain yeeres to come, finde what the Arrearages forborne for all the time are worth in ready money.

So in the example last premised, if the annuity of 16 yeers were not to beginne till after the expiration of 5 yeeres, in this case you are to inquire what the arrearages (*viz.* 363, *l.* 17, *s.* 9, *d.*) being forborne 21 yeers, are worth in ready money, which you shall likewise finde (by the twelfth Probleme before cited) to be 72. 288, which being reduced is 72, *l.* 5. *s.* 9, *d.* the value of the lease required.

PROBL.

PROBL. XVI.

A summe of money being propounded, to finde what annuity (to continue any number of yeers, and according to any rate given) that summe will buy.

TAke any annuity at pleasure, then finde the value of that annuity in ready money: This done, the Proportion will be as followeth.

As the value found is to the Annuity taken; so is the sum given to the annuity required.

Example, what annuity (to continue 16 yeeres) will 1205, l. deserve, so that the purchaser may gaine after the rate of 8. *l. per centum*? Here first I take 12. *l. per annum* to continue 16 yeers, and finde the value thereof in ready money (by the 15 Probleme of this Chapter) to be 106.21, or 106, *l.* 4. *s.* 2, *d.* I say therefore.

If 106.21, *l.* give 12, *l per annum.*

What will 1205, *l.* yeeld? *Facit* 171.39, *per annum* which being reduced is 171, *l.* 7, *s.* 9, *d.* I conclude therefore that 171, *l.* 7 *s.* 9, *d.* is the annuity (to indure 16 yeeres) which 1205, *l.* doth deserve, after the rate of 8 *per centum*.

If.

If any desire to have these Problemes of Interest farther exemplifyed, let them turne to the two last Chapters of the Appendix of my Arithmetik.

PROBL. XVII.

Any number of souldiers being given, to order them into a square battaile of men.

Take halfe the Logarithm of the number given; this done, that halfe is the Logarithm of the number of men, that ought to be placed in Ranke and File to make a square Battail of men.

Example, 573. Souldiers are propounded to be thus ordered; Here the Logarithm of 573 is 2,758155, whose halfe is 1,379077 *viz.* the Logarithm of 23.937; I say therefore, that 23 men ought to bee placed in Ranke, and as many likewise in File to make a square Battaile of the 573 Souldiers propounded: And here observe, that the Decimall .937 is altogether neglected, because Fractions are not to be considered in questions, that concern Military orders.

PROBL.

PROBL. XVIII.

Any number of Souldiers being propounded, to order them into a double battaile of men, viz. which may have twice so many in Ranke, as in File.

TAke half the Logarithm of half the number given; this done, that halfe Logarithm is the Logarithm of the number of men to be placed in File, and the same number doubled will shew you how many ought to be placed in Rank.

Example, 1342 Souldiers being propounded to be put into that order, I demand how many ought to be placed in Ranke, and how many in File: Here halfe 1342 is 671, whose Logarithm is 2,826723, which being halfed is 1,413361, whose correspondent number is 26, &c. I conclude therefore, that to order 1342 Souldiers into a double Battail, you are to place 26 men in File, and 52 in Ranke.

PROBL.

PROBL. XIX.

Any number of Souldiers being given, to order them into a quadruple battaile, viz. *such as may have foure times so many in Ranke as in File.*

TAke half the Logarithm of a fourth part of the number given; this done that halfe Logarithm is the Logarithm of the number of men to be placed in File, and the same number being multiplyed by 4 *will shew you how many men ought to be placed in Ranke.*

Example, 2048 Souldiers being offered to be put into this order; Here the fourth part of 2048 is 512, whose Logarithm is 2,709270 which being halfed is 1,354635, whose proper number is 22,&c. I say therefore that to order 2048 Souldiers into a quadruple Battail, 22 men ought to be placed in File, and 88 in Ranke. And here note that to distinguish this from other orders, the French call it, *Bataillon de grand front*, from whence likewise we usually terme it a *Battail of the great Front.*

PROBL.

PROBL. XX.

Any number of Souldiers being propounded, to order them in Ranke and File according to the reason of any two numbers given.

ADde the Logarithm of the given number of Souldiers, to the Logarithm of the proportionall number given for the Ranke; this done, if out of their Aggregate you deduct the Logarithm of the proportionall number given for the File, halfe the Remainder is the Logarithm of the number of men to be placed in Ranke, which Logarithm if you substract out of the Logarithm of the whole number of souldiers, the Remainder is the Logarithm of the number to be placed in File.

Example, 2500 Souldiers are so to be ordered, that the number of men placed in File may beare such Proportion to the number of men placed in Ranke, as 5 beare to 12; In this demand the proportion will be this, *as 5 to 12, so 2500 to another number, whose square root is the number of men to be placed in Ranke*: Wherefore if you adde 1,079181 the logarithm of 12, to 3,397940 the Logarithm of 2500, their Aggregate is 4,477121, out

out of which if you substract 0,698970 the Logarithm of 5, the Remainder is, 3,778151 whose halfe being 1,889075 is the Logarithm of 77, &c. the number of men to bee placed in ranke; and now if out of 3,397940 the logarithm of 2500 you deduct 1,889075 the Logarithm of the number of men in Ranke, the Remainder (*viz.* 1,508865) is the Logarithm of 32, &c. the number of men to be placed in File.

PROBL. XXI.

Any number of Souldiers being given, together with their distances in Ranke and File, to order the same Souldiers into a square Battaile of Ground.

ADde the Logarithm of the distance in Ranke to the Logarithm of the number of Souldiers; this done, if out of their summe you substract the Logarithm of the distance in File, halfe of that which remaines is the Logarithm of the number of men to be placed in File, which Logarithm being deducted out of the Logarithm of the whole number of Souldiers, the Remainder is the Logarithm of the number of men to be placed in Ranke.

Ex-

Example, 2500 men are propounded to be ſo marſhalled into a ſquare Battail of ground, that their diſtance in File being 7 foot and their diſtance in *Ranke* 3 foot, the ground whereupon they ſtand may be juſt ſquare: Here the Proportion will be this, *As* 7 *to* 3 *ſo* 2500 *to another number whoſe ſquare root is the number of men to be placed in File:* Wherefore if you adde 0,477121 the Logarithm of 3 (the diſtance in Ranke) to 3,397940 the Logarithm of 2500, their ſumme is 3,875061, out of which if you ſubſtract 0,845098 the Logarithm of 7, the diſtance in File, the Remainder is 3,029963, whoſe halfe being 1,514981 is the Logarithm of 32, &c. the number of men to be placed in File; and now if out of 3,397940 the Logarithm of 2500 you ſubſtract 1,514981 the Logarithme of the number of men in File, that which remaines, *viz* 1,882959, is the Logarithm of 76, &c. The number of men to be placed in Ranke. And note, that this order is termed a ſquare *Battail*, as wel as that mentioned in the ſeventeenth Probleme aforegoing, yet is there much difference betwixt them, for in a ſquare Battail of men the number of men in Ranke is alwaies equall to the number of men in File, though the ground

ground whereon they ſtand, be not alwaies a juſt ſquare; contrariwiſe, in a ſquare Battail of ground it is neceſſary, that the place, on which they ſtand, ſhould be alwaies a juſt ſquare, though the number of men in Ranke be not equall to the number of men in File: And therefore the French (as well as we) call that order *Battaillon quarre d' homines* a ſquare battail of men, & this *Battaillon quarre de Terrain* a ſquare Battail of ground.

PROBL. XXII.

Any number of Souldiers being propounded together with the diſtances in Ranke and File, to order them in Ranke and File according to the reaſon of any two numbers given.

Having added the Logarithmes of the diſtance in File and of the proportionall number given for the Ranke to the Logarithm of the number of Souldiers propounded, ſubſtract out of that Aggregate the ſumme of the Logarithmes of the diſtance in Ranke and of the proportionall number given for the File; this done, halfe that which remaines is the Loga-

garithm of men to be placed in Ranke, which Logarithm being substracted out of the Logarithm of the whole number of Souldiers, the remainder is the Logarithm of the number of men to be placed in File.

Example, 12750 are so to bee ordered, that the distance betwixt man and man may be 7 foot upon the File and 3 foot upon the Ranke, and that the length of ground for the Ranke may beare the same proportion to the length of ground for the File, that 12 beares to 5; Here the Logarithm of 7 (the distance in File) is 0,845098; the Logarithm of 12 (the proportional number given for the rank) is, 1,079181; and the Logarithm of 12750 (the number of Souldiers propounded) is 4,105510; the aggregate of these three Logarithmes is 6,029789: Again the Logarithmof 3 (the distance in Rank) is 0,477121, and the Logarithm of 5 (the proportionall number given for the File) is 0,698970; these two last Logarithmes being added together, their summe is 1,176091, which being deducted out of the Aggregate of the three former Logarithmes, the remainder is 4,853698, whose halfe being 2,426849. is the Logarithm of 267, &c. the number of men to bee placed in ranke; And now if I substract the

same

ſame Logarithm 2,426849 out of 4,105510 the Logarithm of 12750, the number of ſouldiers propounded, the Remainder, (*viz* 1,678561) is the Logarithm of 47, &c. the number of men to be placed in file.

CHAP. VI.

The uſe of the Logarithmeticall Tables in the reſolution of right line Triangles.

THus much concerning the uſe of the Logarithmeticall Tables in Arithmetik, now follows their uſe in Geometry, which is chiefly diſcovered in the reſolution of Triangles: And now according to the diviſion of Triangles into right lined, and Sphericall, we will firſt ſhew their uſe in the reſolution of right line Triangles.

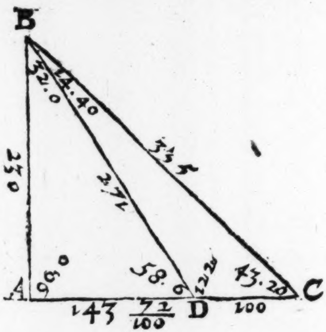
PROBL.

PROBL. I.

The three Angles, and one side of a right Line Triangle being known; to finde either of the other sides.

AS the sine of the Angle opposed to the side given is to the parts of the same side: So is the sine of the Angle opposed to the side required, to the parts of that side, and therefore,

Adde the Logarithm of the side given to the sine of the Angle opposed to the side required; then substract out of that summe the sine of the Angle opposed to the same side given: this done, the number that appertaines to the Logarithm remaining, is the length of the side you look for.



Example

Example, In the Triangle C. B. D. of the Diagram annexed, let the Angle D. bee 122. degrees, and the Angle C. 43 degrees 20. min. and by consequent the Angle B. (being the complement of the two other Angles to 180. degrees) must needs be 14 degrees 40. *min*. And let the side D.C. being 100 .paces represent the distance betwixt the two stations D. and C. this supposed, I demand the distance betwixt D. and B. The Logarithm of the side D. C. (*viz* of 100) by the second Probleme of the fourth chapter is 2,000000 and the sine of 43 degrees 20.*min*. (the Angle opposed to the side required) is 9,836477. by the 11 Probleme of the same chapter. The summe of these is 11,836477. From which if I substract 9,403455 .the sine of the Angle B. opposed to the side known, the Logarithm which remaines is 2,433022. Unto which (by the 9. Probleme of the said 4 chapter) answers the number 271. which is the length of the side D. B. required, *viz*. 271 paces. For

As the sine of	14.40.	9,403455
Is to the side gi.	100.	2,000000
So is the Sin. of	43.20	9,8 6477
		11,836477
To the side requi.	271.	2,433022

PROBL.

PROBL. II.

Two sides of a right line Triangle, and an Angle opposite to one of them being known; to finde the Angle opposed to the other side.

As the side opposed to the Angle given is to the sine of the same Angle: So is the other side known, to the sine of his opposite Angle.

So the side D. C. being 100. the side D.B. 271. and the Angle B. 14. Degrees 40. *min.* the Angle C. will be found 43. Deg. 20. min. For

As the side D. C.	100.	2,000 00
To the sin. of B.	14.40	9,403455
So is the side D.B.	271.	2,433022
		11,836477
To the sin. of C.	43.20.	9,836477

PROBL. III.

Having two sides, and the Angle between them, to finde the other two Angles, and the third side.

1. If

1. IF the Angle included be a right Angle' the proportion will be ſuch:

As the greater ſide is to the leſſer, ſo is the Radius to the Tangent of the leſſer Angle.

So in the Triangle A. B. D. of the Diagram premiſed, the ſide A. B. being 230. and the ſide D. A. 143 $\frac{72}{1}$ The angle A. B. D. will be 32. degrees; For,

As the ſide	230	2,361728
Is to the ſide 143 $\frac{15}{100}$		2,157517
So is the Radius		10,000000
		1,2157517
To the Tan. of 32 *Deg.*		9,795789

2. But if the Angle Included be oblique; then,

As the ſumme of the ſides given is to the difference of the ſame ſides: ſo is the Tangent of the halfe ſumme of the Angles unknown to the Tangent of the halfe of their difference.

Example, In the Triangle C. B. D. the ſide D. B. being 271, the ſide D. C. 100. and the Angle D. 122. degrees. I demand the angles B. and C. The ſumme of the ſides D. B. and D. C. is 371. the difference of them is 171. and the angle D. being 122. degrees, the

ſumme

summe of the other angles unknown is 58. degrees and therefore the halfe of it is 29. degrees; I say then,

As the summe	371	2,569374
Is to the differ.	171	2,232996
So is the Tan of	29.*d.*	9,743752
		11,976748
To the Tang. of	14.20.	9.407374

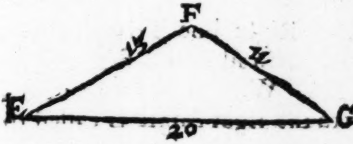
Now these 14 degrees 20. min. being added to 29. d. the halfe summe of the angles unknown, the summe will be 43. degrees. 20. min. *viz.* the angle C. Then substracting the said 14. degrees 20. min. from 29. degrees you have 14. degrees 40. min. for the angle B. Lastly, knowing the three angles, and two sides, the third side may be found by the first Probleme of this chapter.

PROBL. IV.

Having the three sides of a Triangle to finde the superficiall content.

Adde the three sides together, then from the halfe summe substract each side, to the end you may have the difference betwixt that halfe summe and each side; this done, adde the Logarithmes of the said halfe summe, and of

of thoſe differences together: and laſt of all dividing the ſumme of thoſe Logarithms by 2, you have the Logarithm of the content required.



Example, the three ſides of the Triangle E.F.G. being 20, 13, and 11. how much is the ſuperficiall content thereof? The ſumme of the ſides is 44. the halfe ſumme is 22. the differences betwixt each ſide, and that halfe are 2. 9. and 11. which numbers ranke in this order following.

The halfe ſumme	22	1,342423
	2	0,301030
The differences.	9	0,954243
	11	1,041393
The ſumme of the Logarith.		3,639089
The content required 66.		1,819544

 CHAP.

CHAP. VII.

The use of the Logarithmeticall Tables in the resolution of sphericall Triangles.

FRom Right line Triangles come wee to Sphericall, and first to Rectangle Triangles. Where observe that the side opposite to the right Angle is called the Base, but the other two retaine alwaies the name of sides.

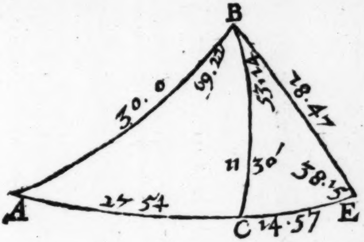
In Rectangle Triangles.

PROBL. I.

The two sides being given, to find the Base.

AS the Radius is to the Cosine of one of the sides: so is the Cosine of the other side to the Cosine of the Base.

Example,



Example, In the Triangle A. B. C. of the Diagram annexed, the ſide A. C. being 27. degrees 54. minutes, and the ſide C. B. 11. degrees 30. minutes, the Baſe B. A. will bee found 30 deg. For,

As the Radius		10,000000
To the Coſ. of	27.54.	9,946337
So is the Coſ. of	11.30.	9,991193
		19,937530
To the Coſ. of 30. *Deg.*		9,937530

PROBL. II.

The two ſides being given, to know either of the oblique Angles.

As the ſine of the ſide next the Angle inquired is to the Radius; ſo is the Tangent of the oppoſite ſide, to the Tangent of the Angle required.

So in the same Triangle A. C. being 27. degr. 54. min. and B. C. 11. deg. 30. min. the angle A. will bee found 23. degrees 30. minutes; For,

As the Sin. of	27.54.	9,670181
To the Radius		10,000000
So is the Tan. of	11.30.	9,308463
		19,308463
To the Tang. of	23.30.	9,638282

PROBL. III.

The Base, and one of the oblique Angles being given, to find the other oblique Angle.

As the Radius is to the Cosine of the Base, so is the Tangent of the Angle given, to the Cotangent of angle inquired.

Example; the Base B. A. being 30 degrees, and the angle A. 23. deg. 30 minutes, the angle B. will be 69. deg. 22. min.

PROBL. IIII.

The Base, and one of the oblique Angles being given, to find the side next unto the same Angle.

As

AS the Radius is to the Cosine of the Angle known: so is the Tangent of the Base, to the Tangent of the side required.

So B. A. being 30 degrees, and the angle A. 23 degrees 30. min. the side A. C. will be found 27 degrees, 54. minutes.

PROBL. V.

The Base, and one of the oblique Angles being known, to finde the side opposed to the same Angle.

AS the Radius is to the sine of the Base: so is the sine of the Angle given to the sine of the side inquired.

So B. A. being 30 deg. and the angle A. 23. degr. 30. min. the side C. B. opposite to the same angle will bee found 11. degr. 30 min.

PROBL. VI.

One of the sides and the oblique Angle next unto it being given, to finde the Base.

AS the Cosine of the Angle given is to the Radius, so is the Tangent of the side given to the Tangent of the Base.

Example, the side A. C. being 27 degrees

54. min. and the angle A. 23. degrees 30. min. you shall find the Base 30. degrees.

PROBL. VII.

One of the sides, and the oblique Angle next unto it being knowne, to finde the other side.

As the Radius is to the sine of the side given, so is the Tangent of the Angle given to the Tangent of the side required.

So A. C. being 27 degrees 54 min. and the angle A. 23 degrees 30 minutes, the side C. B. will be found 11 degr. 30 minutes.

PROBL. VIII.

One of the sides, and the oblique Angle next unto it being known; to finde the other oblique Angle:

As the Radius to the Cosine of the side given, so is the sine of the Angle given to the Cosine of the Angle required.

So A. C. being 27 degrees 54 minutes, and the angle A. 23 degrees 30 minutes, you shall find the angle B. 69 degr. 22 min.

PROBL.

PROBL. IX.

One of the ſides, and the Angle oppoſed unto it being known, to finde the Baſe.

AS the ſine of the Angle given to the ſine of the ſide given; ſo is the Radius to the ſine of the Baſe.

So the ſide B. C. being 11 degrees 30 min. and the angle A. 23 degr. 30 min. the Baſe will be found 30 degr.

PROBL. X.

One of the ſides, and the Angle oppoſed unto it being given; to finde the other ſide.

AS the Tangent of the Angle given is to the Tangent of the ſide; ſo is the Radius to the ſine of the ſide required.

So B.C. being 11.30 and the angle A. 23. 30, the ſide A.C. will bee 27.54.

PROBL. XI.

One of the sides and the Angle opposed unto it being given, to find the other oblique Angle.

AS the Cosine of the side given is to the Cosine of the Angle given; so is the Radius to the sine of the Angle required.

So B. C. being 11. 30, and the angle A. 23.30, the angle B, will be found 69. 22.

PROBL. XII.

One of the sides, and the Base being known, to finde the oblique angle adjacent unto the same side.

AS the Tangent of the Base is to the Tangent of the side given; so is the Radius to the Cosine of the Angle required.

So the side A. C. being 27 degrees 54 min. and the base B.A. 30 degrees 0 minutes, the angle A. will bee found 23 degrees 30 minutes.

PROBL. XIII.

One of the sides, and the Base being known; to find the Angle opposed unto the same side.

As the sine of the Base is to the Radius so is the sine of the side given to the sine of the angle required.

So A.C. being 27 degrees 54 minutes, and B.A. 30 degrees 0 minutes, the angle B. will be found 69 degrees 22 minutes.

PROBL. XIV.

One of the sides, and the Base being given, to find the other side.

As the Cosine of the side given is to the Radius; so is the Cosine of the Base to the Cosine of the side required.

So A. C. being 27 deg. 54 min. and B. A. 30 deg. 0 min. the side B.C. will be found 11 deg. 30. min.

PROBL.

PROBL. XV.

The two oblique Angles being given, to find the Base.

AS the Tangent of one of the Angles is to the Cotangent of the other angle; so is the Radius to the Cosine of the Base.

So the angle A. being 23 deg. 30 min. and the angle B. 69 deg. 22 min. the base B. A. will be found 30 deg. 0 min.

PROBL. XVI.

The two oblique Angles being given, to find either of the sides.

AS the sine of one of the Angles is to the Cosine of the other angle; so is the Radius to the Cosine of the side opposite to the angle whose Cosine was taken.

So the angle A. being 23 degrees 0 min. and the angle B. 69 deg. 22 min. the side A. C. will be found 27 deg. 54 min.

In all Sphericall Triangles.

PROBL. XVII.

Two Angles and a side opposed to one of them being given, to find the side opposed to the other.

AS the sine of the angle opposed to the side known is to the sine of the same side; so is the sine of the angle opposed to the side required to the sine of that side.

So in the Triangle A.B.E. of the last Diagram the angle E. being 38 degrees 15 min. the side B.A. 30 degrees 0 min. and the angle A. 23 degrees 30 min. the side B.E. will be found 18, 47.

PROBL. XVIII.

Two sides, and an Angle opposed to one of them being knowne, to finde the Angle opposed to the other.

AS the sine of the side opposed to the Angle given is to the sine of the same Angle, so is the sine of the side opposed to the angle inquired, to the sine of that Angle.

Example, In the said Triangle A.B.E. the said B A being 30 degrees 0 min. the angle E. 38 degrees 15 min. and the side B. E, 18. deg. 47 min. the angle A. will be found 23.30.

PROBL. XIX.

Two sides, and the Angle included betwixt them being given, to finde the other side.

TO resolve this Probleme, it is necessary to let fall a Perpendicular from one of the angles unknown upon one of the sides given; and by this meanes to change the Triangle propounded into two Rectangle Triangles.

For example, the said Triangle A.B.E, being propounded, of which the sides A.B, and A.E, as also the angle A, are knowne, and the side B.E. is required. Letting fall from the angle B. the perpendicular B.C, upon the side A.E; by the 5 Probleme of this chapter (for as the Radius is to B A, so is the angle A. to the Perpendicular B. C.) the Triangle A.B. E, becomes two Rectangle Triangles, *viz*. A.C. B, and B.C.E. Now the operation being thus prepared, in the Triangle A.C. B, the side B.A, and the angle A being known the side A.C, may be found by the fourth Probleme of this chapter, which being substracted from the side A.E, the remainder will be C. E. *viz:* one of the sides of the Rectangle B.C.E, and by consequent in the said Rectangle B. C.E. the sides B. C, and C. E, being known, the base B.E, (*viz.* the side required) may be found by the first Probleme of this chapter.

Some-

Sometimes the perpendicular will fall out of the Triangle propounded; so if the Triangle A.B.D. were propounded, the perpendicular would fall upon the side A.D. being prolonged as farre as the point C. and in this Case the two Rectangle Triangles are A.C.B. and D.C.B, and therefore the side B.D, required may bee likewise found by the Problemes of Rectangle Triangles.

PROBL. XX.

Two sides, and the Angle included betwixt them being given, to finde either of the other Angles.

HEre you must let fall the perpendicular from one of the angles unknowne upon the side adjacent to the angle required, and then resolve it by the Problemes of Rectangle Triangles, as before.

PROBL. XXI.

Two sides being given, and one of the angles adjacent to the side unknown, to find the same side.

THis Probleme may be resolved also by letting fall a Perpendicular from the angle

angle included betwixt the two ſides known upon the ſide unknowne.

PROBL. XXII.

Two ſides being given, and one of the angles adjacent to the other ſide, to finde the angle included betwixt the ſides given.

FOr the reſolution of this Probleme let the Perpendicular fall from the angle inquired upon his oppoſite ſide.

PROBL. XXIII.

Two angles being given, and the ſide adjacent unto them, to finde either of the other ſides.

IN this caſe you muſt let fall the Perpendicular from one of the angles knowne upon one of the ſides unknown.

PROBL. XXIV.

Two angles being given, and the ſide adjacent unto them, to finde the other angle.

This

THis Probleme is performed by letting fall the Perpendicular from either of the angles known upon his subtending side.

PROBL. XXV.

Two angles being given, and one of the sides adjacent unto the angle unknown, to find the side adjacent unto the angles given.

THis Probleme is resolved by letting fall the Perpendicular from the angle unknown upon the side required.

PROBL. XXVI.

Two angles being given, and one of the sides adjacent unto the angle unknown, to find the same angle.

TO resolve this probleme you must let fall the Perpendicular from the angle unknown upon his opposite side.

PROBL.

PROBL. XXVII.

The three sides being known, to finde any of the angles.

ADde the three sides together, then from the halfe summe substract the side opposite to the angle required; this done, the proportion will be as followeth.

1 *As the Radius is to the sine of one of the sides, which comprehend the angle required, so is the sine of the other side that comprehends the same angle to a fourth sine.*

2 *As that fourth sine is to the sine of the halfe summe of the sides, so is the sine of the difference betwixt the halfe summe and the side opposed to the angle required, to a seventh sine.*

Now if you adde to this seventh sine the Radius, halfe the summe which accrues upon that addition will be the sine of an arke, whose complement being doubled, will give you the angle you look for.

Example, In the said Triangle A.B.E, the the side A B. being 30,0: the side B.E. 18.47. and the side A.E. 42.51. I demand the angle B. The summe of the sides is 91.38. half of this summe is 45.49. and the side A.E 42.51. being substracted from that half summe there remaines 2.58. for the difference betwixt the

said

ſaid halfe ſumme, and the ſaid A. E. I ſay then,

I

As the Radius		10,000000
To the ſine of	30.0	9,698970
So the Sine of	18.47.	9,507843
		19.206813
To the fourth Sine.		9,206813

II.

As the fourth ſine		9,206813
To the ſine of	45.49	9,855588
So the ſine of	2.58.	8,713952
		18,569540
To the ſeventh ſine		9,362727
The Radius		10,000000
The ſumme		19,362727
The halfe ſumme		9,681363

which being ſearcht in the Table of Sines and Tangents will be found the Sine of 28 degr. 42 min. whoſe complement is 61 deg. 18. min. which being doubled is 122.deg.36 min. *viz* the meaſure of the angle A.B.E. required.

PROBL.

PROBL. XXVIII.

The three angles being known, to finde any of the sides.

IF in stead of the greatest angle, you take his complement to 180 degrees, the angles change themselves into sides, and the sides into angles, and by consequent the operation will be the same with that of the last probleme.

AN

AN APPENDIX, CONTAINING

Certaine Rules and Analogies, by helpe whereof the Logarithmeticall Tables may be yet made more usefull.

I. In Geometry.

Probl. 1. *The Diameter of a Circle being knowne, to find the circumference.*

As 1. is to the Diameter; so is 3.1416. (whose Logarithm is 0, 497151) to the circumference.

Probl. 2. *To find the superficiall content.*

As 1. is to the square of the Diameter, so is .785398 (whose Logar. is — 0, 104910) to the content.

Probl. 3. *To find the side of the square, which may be inscribed within the same circle.*

As 1. is to the Diameter ſo is .707107. (whoſe Logar. is — 0,150515) to the ſide of the ſquare to be inſcribed.

Probl. 4. *Having the circumference of a Circle to find the Diameter.*

As 1. is to the circumference, ſo is .318308 (whoſe Logar. is — 0,497153) to the Diameter.

Probl. 5. *To finde the ſuperficiall content.*

As 1. to the ſquare of the circumference, ſo is .079578 (whoſe Log. is — 1,099207) to the content.

Probl. 6. *To finde the ſide of the ſquare which may be inſcribed within it.*

As 1. to the circumference, ſo is .225078 (whoſe Logar. is — 0,647667) to the ſide of the ſquare inſcribed.

Probl. 7. *Having the content of a circle to finde the Diameter.*

As 1. to the content ; ſo is 1.27324 (whoſe Logar. is 0,104910) to the ſquare of the Diameter.

Probl. 8. *To finde the Circumference.*

As 1. to the content ; ſo is 12.5664 (whoſe Logar. is 1,099211) to the ſquare of the circumference.

Probl. 9. *To find the ſide of a ſquare equall unto it.*

Ex-

Extract the square root of the Content given; for that root is the side of the square required.

Probl. 10. *Having the Axis of a Sphere, to finde the superficiall content.*

As 1. is to the square of the axis; so is 3.1416 (whose Logar. is 0, 497151) to the superficiall content.

Probl. 11. *To find the solid content.*

As 1. to the Cube of the axis; so is .52381 (whose Logar. is —0, 280826) to the solid content.

Probl. 12. *In a wine or Beer vessell, the Diameters at the Bongue and head being known, to find the æquated Diameter.*

Multiply the difference of the two Diameters given by 3; this done, if removing that product a place towards the right hand, you deduct it out of the Diameter at the bongue, the remainder will be the æquated Diameter required.

So the Diameter at the bongue being 25.50 inches and the Diameter at the head 20.75, the æquated Diameter will be found 24.075, as appeares by the operation hereunto annexed.

	25.500
	20.75
	475
	1.425
	24.075

PROBL.

Probl. 13. *The æquated Diameter and length of a Wine or Beer vessell being known, to finde the content thereof in wine measure.*

Unto the Logarithm of the length and the Logarithme of the æquated Diameter (twice repeated) adde the Logarithm 7,531478. this done, If you cancell the first figure of their summe (towards the left hand) the Remainder towards the right hand, is the Logarithm of the content in wine gallons.

Probl. 14. *To finde the content in ale measure.*

Unto the Logarithm of the length and the Logarithme of the æquated Diameter (twice repeated) adde the Logarithme 7,460122. this done, (if you cancell the first figure of their summe towards the left hand) the Remainder towards the right hand, is the Logarithm of the content in ale gallons.

If any desire to see these problemes exemplifyed, let them turne to the first chapter of my use of Logarithmes in Geometry.

II. In Astronomy.

Probl. 15. *The sunnes greatest declination together with his distance from the next equinoctiall point being known, to find his present declination.*

As

As the Radius to the Sine of the sunnes distance from the next Equinoctiall point; so is the Sine of the Sunnes greatest declination to the Sine of the Declination required.

Probl. 16. *To finde his right Ascension.*

As the Radius to the Tangent of the distance; so is the cosine of the greatest declination to the Tangent of the right ascension.

Probl. 17. *The sunnes greatest declination together with his present declination being known, to finde his right Ascension.*

As the Tangent of the greatest declination is to the Radius; so is the Tangent of the Declination to the Sine of the right ascension.

Probl. 18. *The Elevation of the pole together with the suns declination being known, to find how long the sun riseth or setteth before or after the hour of six.*

As the Cotangent of the Elevation is to the Radius; so is the Tangent of the sunnes declination to the Sine of the ascensionall difference between the hour of six and the sunnes rising or setting.

Probl. 19. *To find the sunnes amplitude.*

As the cosine of the elevation is to the sine

 of

of the Declination; ſo is the Radius to the Sine of the amplitude.

Probl. 20. *The Elevation of the pole, the ſunnes greateſt declination and his diſtance from the next equinoctiall point being known, to finde the amplitude.*

As the coſine of the Elevation is to the ſine of the ſuns diſtance; ſo is the ſine of the ſunnes greateſt declination to the amplitude required.

Probl. 21. *When the ſunne is in the Equinoctiall, by knowing the elevation of the Pole, to finde the Suns height at any time aſſigned.*

As the Radius to the coſine of the elevation, ſo is the ſine of the ſunnes diſtance from ſix a clock to the ſine of the height required.

Probl. 22. *The elevation of the Pole and declination of the ſunne being known, to finde the ſunnes height at the hower of ſix.*

As the Radius to the ſine of the latitude; ſo is the ſine of the declination to the ſine of the height required.

Probl. 23. *To find the ſunnes height at any time aſſigned.*

1. As the Radius is to the cotangent of the Elevation; ſo is the ſine of the Sunnes diſtance from ſix, to the Tangent of an arke, which being ſubſtracted out of the Suns diſtance

ſtance from the Pole, I ſay again,

2. As the coſine of the arke found is to the Coſine of the reſidue of the Suns diſtance from the Pole; ſo is the ſine of the Elevation to the ſine of the height required.

Probl. 24. *To finde the time when the ſun will be due East and west.*

As the Tangent of the Elevation is to the Radius, ſo is the Tangent of the declination to the Coſine of the houre from the Meridian.

Probl. 25. *To finde the ſunnes height when he commeth to be due eaſt and weſt.*

As the ſine of the elevation to the Radius; ſo is the ſine of the declination to the height required.

Probl. 26. *To finde the Sunnes Azimuth at the hour of ſix.*

As the coſine of the elevation is to the cotangent of the declination; ſo is the Radius to the tangent of the azimuth from the North part of the Meridian.

Prob. 27. *The complement of elevation, the Sunnes diſtance from the Pole, and the complement of the ſunnes height being known, to finde the Azimuth.*

Having added the three given termes together finde the difference betwixt their halfe

ſumme, and the Suns diſtance from the Pole; this done, the proportions will be as followeth.

1. As the Radius to the Coſine of the elevation; ſo is the coſine of the height to a fourth ſine.

2. As that fourth ſine is to the ſine of the halfe ſumme; ſo is the ſine of the difference to a ſeventh ſine, unto which if you adde the Radius, halfe that ſumme will be the ſine of an arke, whoſe complement being doubled is the azimuth you look for.

Probl. 28. *To finde the hour of the day.*

Having added the three given termes together, as before, finde the difference betwixt their halfe ſumme and the complement of the Suns height; this done, the proportions will be theſe.

1. As the Radius to the Coſine of the Elevation; ſo is the ſine of the ſuns diſtance from the Pole to a fourth ſine.

2. As that fourth ſine is to the ſine of the halfe ſumme; ſo is the ſine of the difference to a ſeventh ſine, unto which if you adde the Radius, halfe that ſumme will be the ſine of of an arke, whoſe complement being doubled and converted into time will produce the houre required.

III. In Dyalling.

Probl. 29. *To make a direct polar Dyall.*

Having assigned a line drawn in the middle of the Plane for the Meridian, and another line drawn parallell unto it for some other hour which may be described upon the Plane, I say;

1. As the Tangent of that hour is to the Radius; so is the distance of that hour line from the Meridian, to the height of the stile.

2. As the Radius is to the height of the stile; so is the Tangent of any other hour, to the distance of the same hour from the substile.

Probl. 30. *A Meridian Dyall.*

Having drawn a line representing part of the axis of the world towards a proper side of the plane (according to his situation either Eastward or Westward) and assigned that line for the hour of six, the proportions will fall out to be as in the former Probleme; for,

1. As the Tangent of any hours distance from six is to the Radius; so is the distance of the hour upon the Plane from the hour line of six, to the height of the stile.

2. As the Radius is to the height of the

 stile,

ſtile; ſo is the Tangent of any other hours diſtance from ſix, to the diſtance of the ſame hour from the ſubſtile.

Probl. 31. *An Horizontall dyall.*

As the Radius to the Tangent of the hour given, ſo is the ſine of the Elevation, to the Tangent of the hour line from the Meridian.

Probl. 32. *A verticall Dyall.*

As the Radius to the Tangent of the hour, ſo is the Coſine of the Elevation to the Tangent of the hour line from the Meridian.

Probl. 33. *A verticall inclining Dyall.*

Having found out the elevation of the Pole above the Plane according to its inclination, the proportion will be this;

As the Radius to the Tangent of the hour, ſo is the ſine of the Elevation above the Plane, to the Tangent of the hour line from the Meridian.

Probl. 34. *A verticall declining Dyall.*

1. As the Radius to the cotangent of the Elevation; ſo is the ſine of the declination, to the Tangent of the ſubſtiles diſtance from the Meridian of the place.

2. As the Radius to the coſine of the declination, ſo is the Coſine of the Elevation,

to

to the ſine of the ſtiles height above the ſubſtile.

3. As the ſine of the Elevation is to the Radius;ſo is the Tangent of the declination to the tangent of the inclination of the Meridian of the Plane to the Meridian of the place.

4. As the Radius to the ſine of the ſtiles height above the ſubſtile, ſo is the Tangent of the angle at the pole comprehended between the hour given and the Meridian of the Plane, to the tangent of the hour lines diſtance from the ſubſtile.

Probl. 35. *A Meridian inclining Dyall.*

1. As the Radius is to the tangent of the Elevation; ſo is the ſine of the Inclination, to the tangent of the ſubſtiles diſtance from the meridian.

2. As the Radius is to the ſine of the Elevation;ſo is the Coſine of the Inclination, to the ſine of the ſtiles height above the ſubſtile.

3. As the Coſine of the Elevation is to the Radius ; ſo is the tangent of the inclination,to the tangent of the inclination of meridians.

4. As the Radius is to the ſine of the ſtiles height above the ſubſtile;ſo is the tangent of

of the angle at the Pole, to the Tangent of the hour lines diſtance from the ſubſtile.

Probl. 36. *A Polar declining Dyall.*

1. As the Radius to the ſine of the declination, ſo is the coſine of the Elevation, to the coſine of the arke comprehended between the Horizon and the ſubſtile.

2. As the Radius to the tangent of the declination; ſo is the ſine of the Elevation, to the Tangent of the Inclination of meridians, which being converted into time ſheweth how many hours the ſubſtile ought to be placed from the hour line of 12.

3. As the Radius is to the tangent of the hours diſtance from the ſubſtile; ſo are the parts of the height of the ſtile, to the diſtance of the ſubſtile; from the hour line required, meaſured by a ſcale of like parts.

Probl. 37. *A declining inclining Dyall.*

1. As the Radius to the Tangent of Inclination to the Horizon, ſo is the Coſine of declination, to the Tangent of the arke of the meridian of the place intercepted between the Horizon and the Plane, which being compared with the elevation of the Pole, the diſtance of the Pole from the Plane may be thereby readily diſcovered.

2. As the Radius is to the ſine of declination from

from the verticall; so is the sine of inclination to the Horizon, to the Cosine of the inclination to the meridian.

3. As the Radius is to the cosine of inclination to the Horizon; so is the cotangent of declination, to the tangent of the ark of the Plane intercepted between the Horizon and the meridian of the place.

4. As the Radius is to the sine of the inclination to the meridian; so is the Tangent of the Poles distance from the Plane, to the tangent of the substiles distance from the meridian.

5. As the Radius is to the sine of the poles distance from the Plane; so is the sine of the inclination to the meridian, to the sine of the stiles height above the substile.

6. As the Cosine of the Poles distance from the Plane is to the Radius; so is the cotangent of the inclination to the meridian, to the Tangent of the inclination of meridians.

7. As the Radius is to the sine of the stiles height above the substile; so is the Tangent of the angle at the pole, to the tangent of the hour lines distance from the substile.

IV. In Geography.

Prob. 38. *Two places being propounded, which differ onely in latitude; to finde their distance.*

1. When the two places are scituate under the same meridian and upon the same side of the Equinoctiall; *Substract the lesser latitude out of the greater; that done, the remainder is the distance required.*

2. When one of the places propounded are scituate upon this side of the Equinoctiall, and the other upon that, and yet both under the same meridian as before; *Adde the two latitudes together; this done, their summe is the distance required.*

Probl. 39. *Two places which differ onely in longitude being propounded, to know their distance.*

1. When the places are both of them scituate under the Equinoctiall; *Substract the lesser longitude out of the greater; this done, the remainder is the distance required.*

2. When the places are scituate under some parallel betwixt the Equinoctiall and one of the Poles; Then, *As the Radius is to the cosine of the common latitude given; so is the sine of halfe the difference of longitude, to the sine of halfe the distance.*

Probl. 40. *Two places being given, that differ both in longitude and latitude, to finde their distance.*

1. When one of the places is scituate under the Equinoctiall; and the other towards one of the poles; Then, *As the Radius is to the Cosine of the difference of longitude; so is the Cosine of the latitude given, to the cosine of the distance required.*

2. When both places are without the Equinoctiall, and towards one of the poles, then;

1. *As the Radius is to the Cosine of the difference of longitude; so is the Cotangent of the lesser latitude, to the Tangent of another arke,* which having substracted out of the complement of the greater latitude, retaine the remaining arke thereof, and say;

2. *As the cosine of the arke found is to the Cosine of the arke remaining; so is the sine of the lesser latitude, to the cosine of the distance required.*

3. When both places are without the equinoctiall, and one of them scituate towards the North Pole, and the other towards the south.

1. *As the Radius is to the Cosine of the difference of longitude, so is the Cotangent of one of*

of the latitudes to the Tangent of another ark, which being substracted out of the other latitude and 90 degr. added together; say again,

2. *As the cosine of the arke found, to the cosine of the ark remaining; so is the sine of the latitude first taken, to the cosine of the distance required.*

V. In Navigation.

Probl. 41. *The latitudes of two places being known, to find the Meridionall difference of the same latitudes.*

1. When one of the places is situate under the Equinoctiall, and the other without, *the degrees and minutes (in the Table following) answering to the latitude of that other place are the meridionall difference of those latitudes.*

2. When both the places have Northerly or Southerly latitude, *If you substract the degrees and minutes (in the Table) answering to the lesser latitude out of those answering to the greater latitude, the remainder is the meridionall difference required.*

3. When one of the places hath Southerly and the other Northerly latitude; *The sum of the numbers answering to those latitudes, is the Meridionall difference desired.*

M	G.	Par.	M.	G	Par.	M	G.	Par
0	0	0	3	3	001	6	6	011
		100		3	101		6	111
		200		3	201		6	212
		300		3	301		6	312
		400		3	402		6	413
		500		3	502		6	514
		600		3	602		6	614
		700		3	702		6	715
		800		3	803		6	816
		900		3	903		6	916
1	1	000	4	4	003	7	7	017
	1	100		4	103		7	118
	1	200		4	204		7	219
	1	300		4	304		7	319
	1	400		4	404		7	420
	1	500		4	504		7	521
	1	600		4	605		7	622
	1	700		4	705		7	723
	1	800		4	805		7	824
	1	900		4	906		7	925
2	2	000	5	5	006	8	8	026
	2	100		5	106		8	127
	2	200		5	207		8	228
	2	300		5	307		8	329
	2	400		5	408		8	430
	2	500		5	508		8	531
	2	601		5	609		8	632
	2	701		5	709		8	733
	2	801		5	810		8	834
	2	901		5	910		8	936
3	3	001	6	6	011	9	9	037

M.	G.	Par.	M.	G	Par.	M	G.	Par
9	9	027	12	12	088	15	15	174
	9	138		12	190		15	277
	9	239		12	293		15	381
	9	341		12	395		15	485
	9	442		12	497		15	588
	9	543		12	600		15	692
	9	645		12	702		15	706
	9	746		12	805		15	900
	9	848		12	907		16	004
	9	949		12	010		16	107
10	10	051	13	13	112	16	16	211
	10	152		13	215		16	316
	10	254		13	318		16	420
	10	355		13	421		16	524
	10	457		13	523		16	628
	10	559		13	626		16	732
	10	661		13	729		16	836
	10	762		13	832		16	941
	10	864		13	935		17	045
	10	966		14	038		17	150
11	11	068	14	14	141	17	17	255
	11	170		14	244		17	359
	11	272		14	347		17	464
	11	374		14	450		17	568
	11	476		14	553		17	673
	11	578		14	656		17	778
	11	680		14	760		17	883
	11	782		14	863		17	988
	11	884		14	967		18	093
	11	986		15	070		18	198
12	12	080	15	15	174	18	18	303

M	G.	Par.	M	G.	Par.	M	G.	Par
18	18	303	21	21	486	24	24	734
	18	408		21	593		24	844
	18	513		21	701		24	953
	18	619		21	808		25	063
	18	724		21	915		25	173
	18	830		21	023		25	282
	18	939		22	130		25	392
	19	041		22	238		25	502
	19	146		22	345		25	613
	19	251		22	453		25	723
19	19	356	22	22	561	25	25	833
	19	463		22	669		25	943
	19	569		22	777		26	054
	19	675		22	815		26	164
	19	781		22	993		26	278
	19	887		23	101		26	386
	19	993		23	210		26	497
	20	100		23	318		26	608
	20	206		23	427		26	719
	20	312		23	535		26	830
20	20	419	23	23	643	26	26	941
	20	525		23	752		27	052
	20	632		23	861		27	164
	20	738		23	970		27	275
	20	845		24	079		27	387
	20	952		24	188		27	499
	21	059		24	297		27	610
	21	165		24	406		27	722
	21	272		24	515		27	834
	21	379		24	624		27	946
21	21	486	24	24	734	27	27	058

M	G.	Par.	M	G.	Par.	M	G.	Par.
27	28	058	30	31	473	33	34	992
	28	171		31	588		35	111
	28	283		31	704		35	231
	28	396		31	820		35	350
	28	508		31	936		35	470
	28	621		32	052		35	590
	28	734		32	168		35	710
	28	847		32	284		35	830
	28	959		32	400		35	950
	29	072		32	517		36	071
28	29	186	31	32	633	34	36	191
	29	299		32	750		36	312
	29	413		32	867		36	433
	29	526		32	984		36	554
	29	640		33	101		36	675
	29	753		33	218		36	796
	29	867		33	336		36	917
	29	981		33	453		37	039
	30	095		33	571		37	161
	30	300		33	688		37	283
29	30	824	32	33	806	35	37	405
	30	438		33	924		37	527
	30	553		34	042		37	649
	30	6[illegible]		34	161		37	771
	30	782		34	279		37	894
	30	897		34	397		38	017
	31	012		34	516		38	140
	31	127		34	635		38	263
	31	242		34	754		38	386
	31	357		34	873		38	509
30	31	473	33	34	992	36	38	633

M	G	Par.	M	G.	Par.	M	G.	Par.
36	38	633	39	42	415	42	46	362
	38	757		42	544		46	496
	38	880		42	673		46	631
	39	004		42	802		46	766
	39	129		42	931		46	902
	39	253		43	061		47	037
	39	377		43	191		47	173
	39	502		43	320		47	309
	39	627		43	451		47	445
	39	752		43	581		47	581
37	39	877	40	43	711	43	47	718
	40	002		43	842		47	855
	40	128		43	973		47	992
	40	253		44	104		48	129
	40	379		44	235		48	267
	40	505		44	366		48	404
	40	6,1		44	498		48	542
	40	757		44	630		48	681
	40	884		44	762		48	819
	41	011		44	894		48	958
38	41	137	41	45	026	44	49	097
	41	264		45	159		49	236
	41	392		45	292		49	375
	41	519		65	425		49	515
	41	646		45	558		49	655
	41	774		45	691		49	795
	41	902		45	825		49	935
	42	030		45	959		50	076
	42	158		46	093		50	217
	42	287		46	227		50	358
39	42	415	42	46	362	45	50	499

M	G	Par.	M	G.	Par.	M	G.	Par.
45	50	49	48	54	860	51	59	481
	50	641		55	010		59	640
	50	783		55	160		59	800
	50	925		55	310		59	960
	51	068		55	460		60	120
	51	210		55	611		60	280
	51	351		55	762		60	441
	51	496		55	913		60	602
	51	639		56	065		60	763
	51	783		56	117		60	925
46	51	927	49	56	369	52	61	088
	52	071		56	522		61	250
	52	215		56	675		61	413
	52	360		56	828		61	577
	52	505		56	981		61	740
	52	650		57	135		61	904
	52	795		57	289	53	62	069
	52	941		57	444		92	234
	53	087		57	598		62	399
	53	233		57	754		62	564
47	53	380	50	57	909		62	730
	53	526		58	065		62	897
	53	673		58	221		63	063
	53	821		58	377		63	231
	53	968		58	534		63	398
	54	116		58	691		63	566
	54	264		58	848		63	734
	54	413		59	006		63	903
	44	562		59	164		64	072
	54	711		59	322		64	242
48	94	860	51	59	481	54	64	412

M	G.	Par	M	G.	Par	M.	G	Par
54	64	412	57		711	60	75	456
	64	582		69	895		75	656
	64	753		70	080		75	857
	64	924		70	263		76	059
	65	096		70	449		76	261
	65	268		70	635		76	464
	65	440		70	821		76	667
	65	613		71	008		76	871
	65	786		71	195		77	076
	65	960		71	383		77	281
55	66	134	58	71	572	61	77	487
	66	308		71	761		77	694
	66	483		71	950		77	901
	66	659		72	140		78	109
	66	835		72	331		78	317
	67	011		72	522		78	526
	67	188		72	714		78	735
	67	365		72	906		78	947
	67	543		73	099		79	158
	67	721		73	292		79	370
56	67	900	59	73	486	62	79	583
	68	079		73	680		79	799
	68	258		73	875		80	010
	68	438		74	071		80	225
	68	618		74	267		80	441
	68	799		74	464		80	657
	68	981		74	661		80	874
	69	163		74	859		81	091
	69	345		75	057		81	310
	69	528		75	256		81	529
57	69	711	0	75	456	63	81	749

M	G.	Par	M	G.	Par	M.	G.	Par
63	81	749	66	88	735	69	96	575
	81	970		88	971		9	354
	82	191		89	219		97	135
	82	413		89	467		97	418
	82	635		89	716		97	701
	82	860		89	967		97	986
	83	084		90	218		98	272
	83	310		90	470		98	560
	83	536		90	723		98	849
	83	763		90	978		99	139
64	83	990	67	91	232	70	69	431
	84	219		91	489		99	724
	84	448		91	746		100	018
	84	678		92	005		100	314
	84	909		92	264		100	612
	85	141		92	525		100	610
	85	374		92	787		101	211
	85	607		93	050		101	513
	85	842		93	314		101	816
	86	077		93	579		102	121
65	86	318	68	93	846	71	102	427
	86	550		94	113		102	735
	86	788		94	382		103	044
	87	027		94	652		103	356
	87	267		94	923		103	668
	87	508		95	195		103	983
	87	749		95	468		104	229
	87	992		95	743		104	616
	88	235		96	019		104	936
	88	480		96	296		105	257
66	88	725	69	96	575	72	105	579

M	Gr.	Par.	M	Gr.	Par	M	Gr.	Par
72	105	579	75	116	171	78	129	075
	105	904		116	559		129	558
	106	230		116	949		130	045
	106	558		117	342		130	536
	106	888		117	737		131	031
	107	220		118	135		131	530
	107	553		118	536		132	034
	107	888		118	639		132	542
	108	226		119	345		133	055
	108	565		119	755		133	572
73	108	906	76	120	166	79	134	094
	109	249		120	581		134	620
	109	594		121	000		135	151
	109	941		121	420		135	687
	110	290		121	843		136	228
	110	641		122	270		136	775
	110	994		122	700		137	326
	111	349		123	133		137	883
	111	707		123	570		138	445
	112	066		124	009		139	012
74	112	428	77	124	452	80	139	585
	112	792		124	898		140	164
	113	158		125	348		140	748
	113	526		125	801		141	339
	113	897		126	258		141	936
	114	270		126	718		142	538
	114	645		127	182		143	147
	115	023		127	649		143	763
	115	403		128	121		144	385
	115	786		128	596		145	014
75	116	171	78	129	075	81	145	650

M	Gr.	Par.	M	Gr.	Par	M	Gr	Par
81	145	650	84	168	947	87	208	705
	146	292		169	912		210	549
	146	940		170	893		212	668
	147	600		171	891		214	645
	148	265		172	907		216	909
	148	937		173	941		219	158
	149	618		174	994		221	498
	150	307		175	067		223	938
	151	003		177	160		226	486
	151	709		178	275		229	153
82	152	423	85	179	411	88	231	950
	153	147		180	569		234	891
	153	878		181	752		237	991
	154	620		182	960		241	268
	155	372		184	194		244	744
	156	132		185	454		248	445
	156	903		186	743		252	402
	157	685		188	062		256	652
	158	478		189	411		261	243
	159	281		190	793		266	235
83	160	096	86	192	210	89	271	705
	160	922		193	661		277	753
	161	761		195	151		284	517
	162	612		196	680		292	191
	163	475		198	251		301	058
	164	352		199	867		311	563
	165	242		201	529		324	455
	166	146		203	240		341	196
	167	055		205	005		365	039
	167	999		206	825	90	408	011
84	168	947	87	208	705			

Infinit

Probl. 42. *The latitudes of two places together with their difference of longitude, being known, to find the Rumb directing from the one to the other.*

As the Meridionall difference is to the difference of longitude; so is the Radius to the tangent of the Rumb.

Probl. 43. *By both latitudes and Rumb, to finde the distance upon the Rumb.*

As the cosine of the Rumb, to the true difference of latitudes; so is the Radius to the distance required.

Probl. 44. *By both latitudes and Rumb, to finde the difference of longitude.*

As the Radius is to the Tangent of the Rumb; so is the Meridionall difference of the latitudes, to the difference of the longitude required.

Probl. 45. *By both latitudes and distance, to find the Rumb.*

As the distance is to the difference of latitude; so is the Radius to the Cosine of the Rumb.

Probl. 46. *By one latitude, distance, and Rumb, to finde the other latitude.*

As the Radius is to the Cosine of the Rumb; so is the distance to the true difference of latitude.

FINIS.

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